Allen-Bradley

Bulletin 161
AC Drive
(Series B)

0.2-3.7kW
(0.3 to 5 hp)
FRN 2.001

User Manual

Important User Information

Solid State equipment has operational characteristics differing from those of electromechanical equipment. "Safety Guidelines for the Application, Installation and Maintenance of Solid-State Controls" (Publication SGI-1.1) describes some important differences between solid-state equipment and hardwired electromechanical devices. Because of this difference, and also because of the wide variety of uses for solid-state equipment, all persons responsible for applying this equipment must satisfy themselves that each intended application of this equipment is acceptable.

In no event will Rockwell Automation be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation cannot assume responsibility or liability for actual use based on the examples and diagrams.

No patent liability is assumed by Rockwell Automation with respect to use of information, circuits, equipment, or software described in this manual.

Reproduction of the contents of this manual, in whole or in part, without written permission of Rockwell Automation is prohibited.

Throughout this manual we use notes to make you aware of safety considerations

ATTENTION: Identifies information about practices or circumstances that can lead to personal injury or death, property damage or economic loss.

Attention statements help you to:

- Identify a hazard
- Avoid a hazard
- Recognize the consequences

IMPOR TAN T: Identifies information that is especially important for successful application and understanding of the product.

Shock Hazard labels located on or inside the drive indicate that dangerous voltage may be present.

Table of Contents

1. Getting Started .....

Important Precautions p.1
Conventions used in this manual p.2
Catalog Number Explanation p.2
Receiving Your New Drive p.3
Nameplate Label p.3
Drive Features p.4

2. Installation & Wiring .....

Storage and Operating Conditions p.5
CE Compliance p.5
Installation p.5
Clearances p.5
Terminal Blocks p.6
Power Wiring p.7
Power Terminal Block Wiring Specifications p.8
Branch Circuit Protection Devices p.8
Input Power Conditioning p.8
Grounding p.8
Control Wiring p.9
Control Terminal Descriptions p.10
Programmable Digital Input (Control terminal block inputs 1 through 5) Functions p.12

3. Parameters & Programming .....

Programming Keypad p.15
Programming Examples p.16
Initial Power Up p.16
Scrolling through parameter groups p.16
Operation of the Drive via the Fixed Keypad p.17
Activating the Speed Pot on the Keypad P.17
Restoring Factory Defaults p.18
Parameter Groups p.19
Parameter Descriptions p.21
- d Group - Display and Diagnostic Parameters (Read Only) p.21
- F Group – Basic Function Parameters p.22
- A Group – Advanced Function Parameters p.22
- b Group – Advanced Control and Protection Parameters p.29
- C Group – Intelligent I/O and Communication Parameters p.33

4. Faults & Troubleshooting .....

Fault Information p.35
How to Clear a Fault p.35
Bulletin 161 Fault Descriptions p.35
Possible Problems and Corrective Actions p.36
Other Displays p.37

5. Specifications & Dimensions .....

Technical Data p.39
Dimensions p.40
Accessories p.42

A. CE Conformity .....

CE Compliance p.43
General Notes and Instructions p.43
Essential Requirements for a Conforming EMC Installation p.43
Motor Cable p.43
Control Cable p.43

Chapter 1 – Getting Started

Important Precautions

In addition to the precautions listed throughout this manual, you must read and understand the following statements which identify hazards associated with AC drives.

ATTENTION

The Bulletin 161 drive contains high voltage DC bus capacitors which take time to discharge after removal of input power. Before working on the drive, wait five minutes for capacitors to discharge to safe voltage levels.
Darkened display LEDs are not an indication that capacitors have discharged to safe voltage levels. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION

This Bulletin 161 drive generates dangerous electrical voltages and controls potentially dangerous rotating mechanical parts. Disregarding the guidelines provided in this manual could result in severe bodily injury or loss of life.

Only personnel familiar with the drive and associated machinery should plan or implement the installation, start-up and subsequent maintenance of the system. Failure to comply could result in bodily injury and/or damage to the equipment.

ATTENTION

This drive contains ESD (Electrostatic Discharge) sensitive parts and assemblies. Static control precautions are required when installing, testing, servicing or repairing this assembly. Component damage may result if ESD control procedures are not followed. Failure to observe this precaution could result in damage to the equipment.

ATTENTION

The drive is intended to be installed with a fixed ground connection. The protective ground only offers protection for the drive, not against personal injury. According to EN 50178 it is not recommended to use the Bulletin 161 drives on protective fault current switches as, due to a possible DC component (rectifier load), the sensitivity of the safety switch will be reduced in the event of a failure. If unavoidable, only type B Residual Current Operated Protective Devices (RCD's) should be used. As a precautionary measure, the EN 50178 regulations should be observed. Failure to observe this precaution could result in severe bodily injury or loss of life.

ATTENTION

An incorrectly applied or installed drive can result in component damage or reduction in product life. Wiring or application errors such as undersizing the motor, supplying an incorrect or an inadequate AC supply, or excessive ambient temperatures may result in system malfunction. Failure to observe this precaution could result in damage to the equipment.

ATTENTION

- **To prevent any injuries or damage, do not touch any components located within the housing with your hands or with any other objects while input voltage is applied or if the DC-bus capacitors are not discharged. Do not carry out any work on the wiring or check any signals if input voltage is applied.**

ATTENTION

- **Ensure that the input voltage corresponds to the voltage indicated on the product nameplate. Environmental influences such as high temperatures and high relative humidity are to be avoided as well as dust, dirt and corrosive gases. The mounting location should be well ventilated and not exposed to direct sunlight. Install the device upright on a non-flammable, vertical wall. Failure to observe this precaution could result in damage to the equipment.**

ATTENTION

- **The drive start/stop and enable control circuitry includes solid-state components. If hazards due to accidental contact with moving machinery or unintentional flow of liquid, gas or solids exist, an additional hardwired stop circuit is required to remove AC input power to the drive.**

- **All the pertinent safety regulations, e.g. accident prevention regulations, professional association regulations, EN, VDE regulations etc. must be observed. As these regulations are implemented differently in different countries, the user must observe the regulations that apply for his particular country.**
  Failure to observe these precautions could result in severe bodily injury or loss of life.

General information

Conventions used in this manual

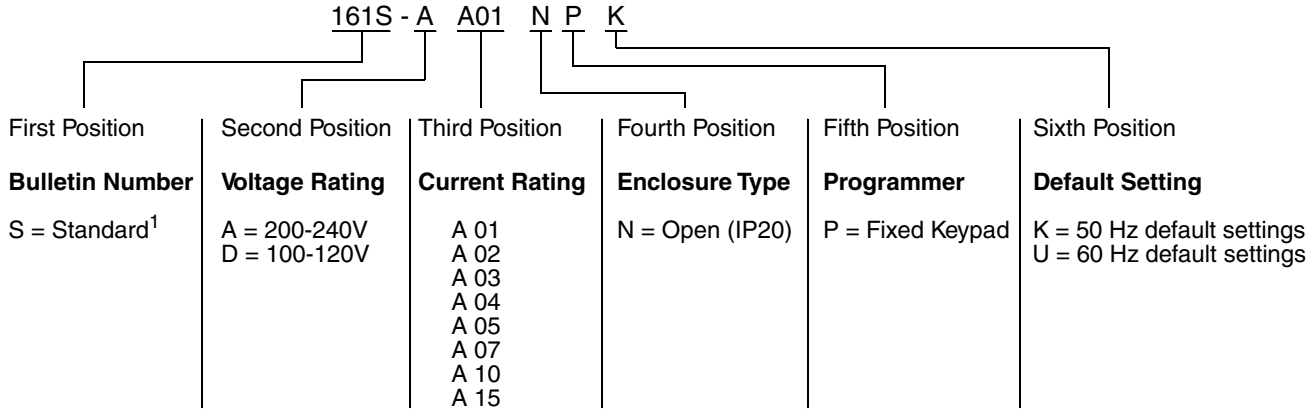
To help differentiate parameter names and parameter settings from other text the following conventions will be used:

- Parameter numbers and names are shown in the following way: **P**d01 - [Output Frequency]
- Parameter Settings for inputs and outputs are shown with the setting number followed by the alpha description in {Braces} ex: 18{RS}

Catalog Number Explanation

Figure 1.1 below describes the 161 catalog numbering scheme. Please note that not all combinations can be configured as a Drive, refer to Chapter 5 – Specifications & Dimensions.

Figure 1.1 Catalog Number



1 Ratings through 3 HP (2.2 KW) are rated for single or three phase input

Receiving Your New Drive

It is your responsibility to thoroughly inspect the equipment before accepting shipment from the freight company. Check the item(s) received against your purchase order. If any items are obviously damaged, do not accept delivery until the freight agent notes the damage on the freight bill.

Unpacking

Remove all packing material, wedges, or braces from within and around the drive. Remove all packing material from the heat sink. Leave the debris cover in place on the top of the drive.

If you find any concealed damage during unpacking, notify the freight agent. Also, leave the shipping container intact and have the freight agent make a visual inspection of the equipment to verify damage.

Inspecting

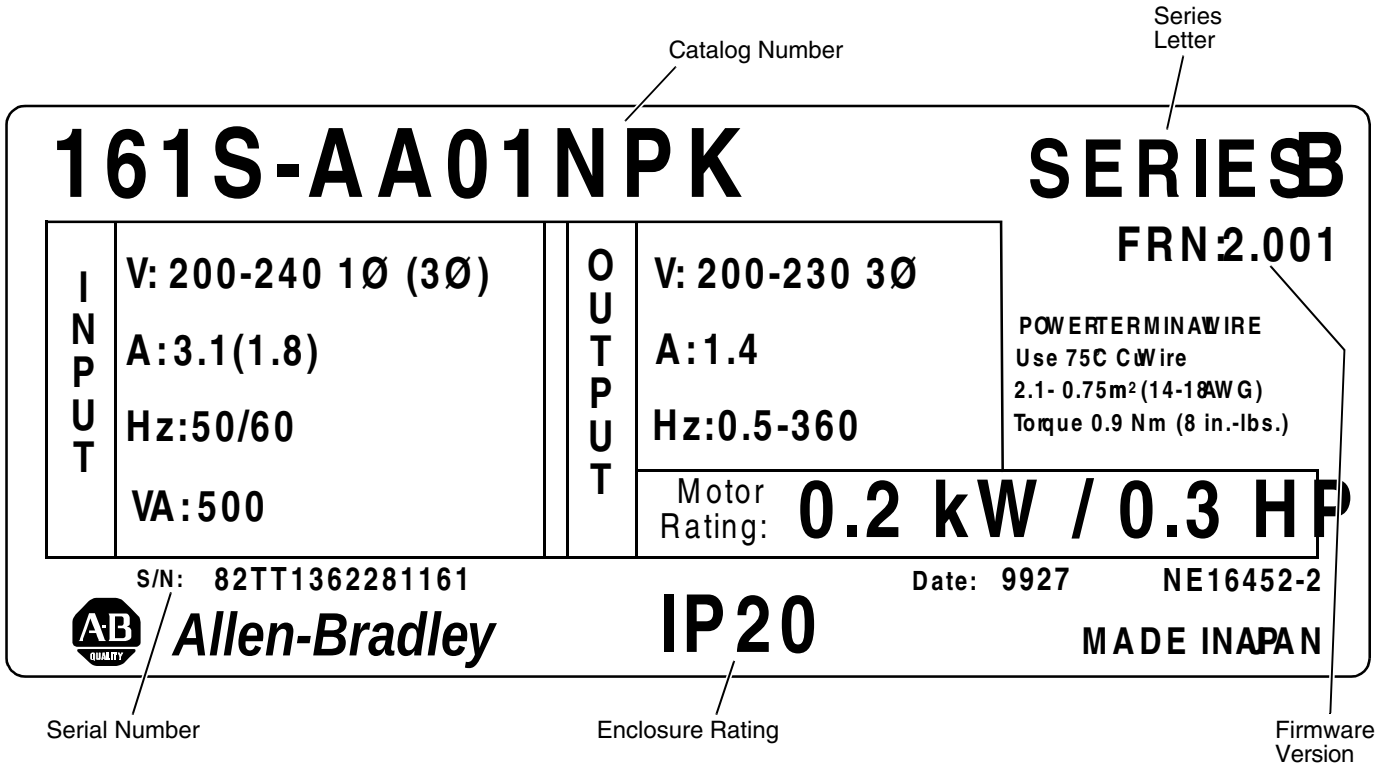
After unpacking, check the item(s) nameplate catalog number against your purchase order. An explanation of the catalog numbering system for the Bulletin 161 drive was provided in Figure 1.1 as an aide for nameplate interpretation.

IMPORTANT: Before you install and start up your Bulletin 161, inspect for mechanical integrity. Look closely for loose parts, wires and connections.

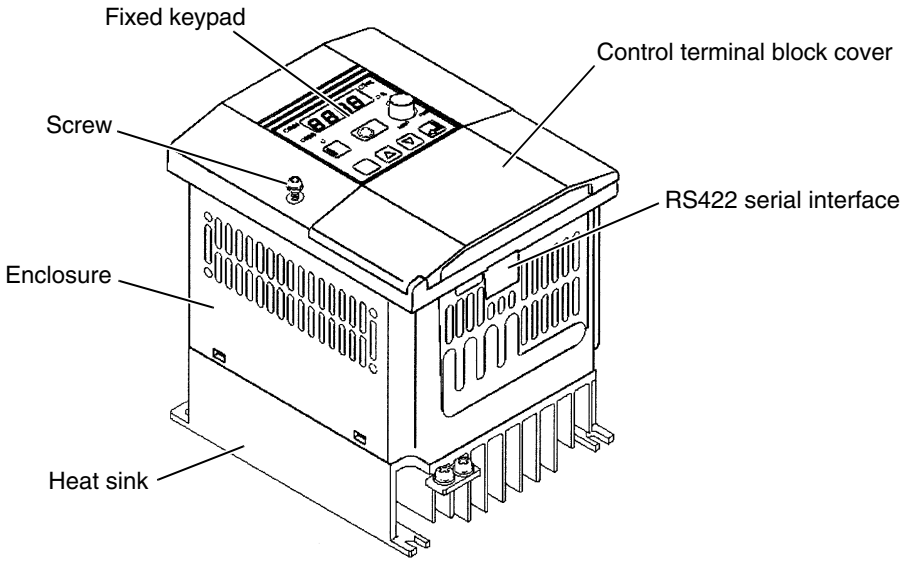
Nameplate Label

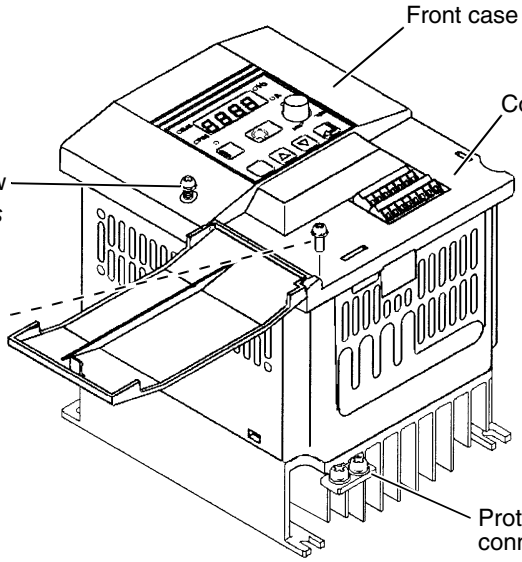
Figure 1.2 depicts a typical Bulletin 161 Nameplate Label.

Figure 1.2 Bulletin 161 Nameplate Label



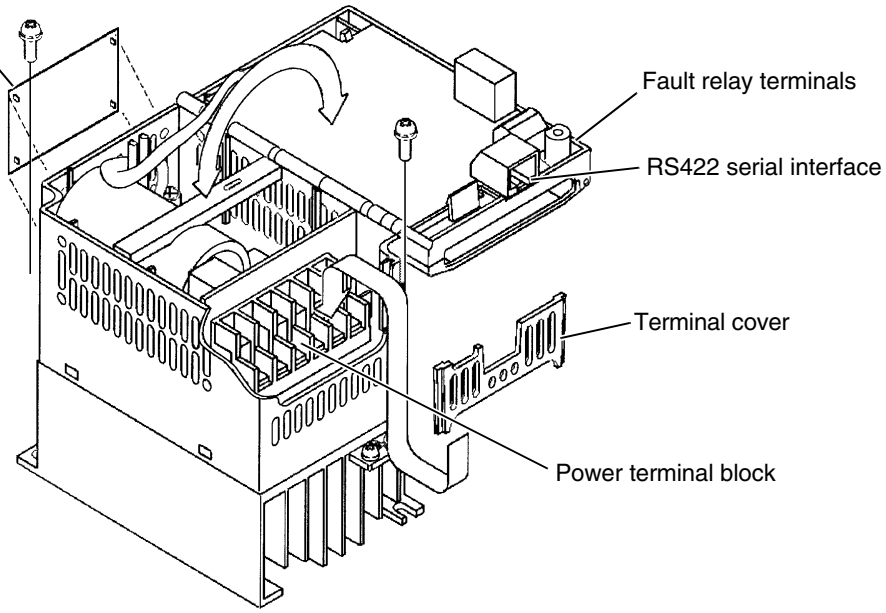
Drive Features





To wire the power terminals and fault relay, loosen the screw and open the front case.

Note that for ratings AA01-AA03 the screw is located under the control terminal block cover.



Chapter 2 – Installation & Wiring

Storage and Operating Conditions

Follow these recommendations to prolong drive life and performance:

- Store within an ambient temperature range of –25°C to 70°C.
- Store within a relative humidity range of 20 to 90%, non-condensing.
- Avoid storing or operating the drive where it could be exposed to a corrosive atmosphere.
- Protect from moisture and direct sunlight.
- Operate within an ambient temperature range of –10°C to 40°C.

IMPORTANT: To operate the drive between 40°C and 50°C, make the following adjustments:

- ➢ Reduce the carrier frequency to 2kHz
- ➢ Reduce the output current to 80% of the drives rated current
- ➢ Remove the debris cover from the top of the drive

CE Compliance

Refer to Appendix A – CE Conformity.

Installation

Mount the drives on a flat, vertical and level surface. Drive orientation must be vertical (top up) for proper heat dissipation.

- Install the drive with screws, recommended screw sizes are listed in the table below. Note that ratings AA01-AA03 require screws at the upper left and lower right corners only.

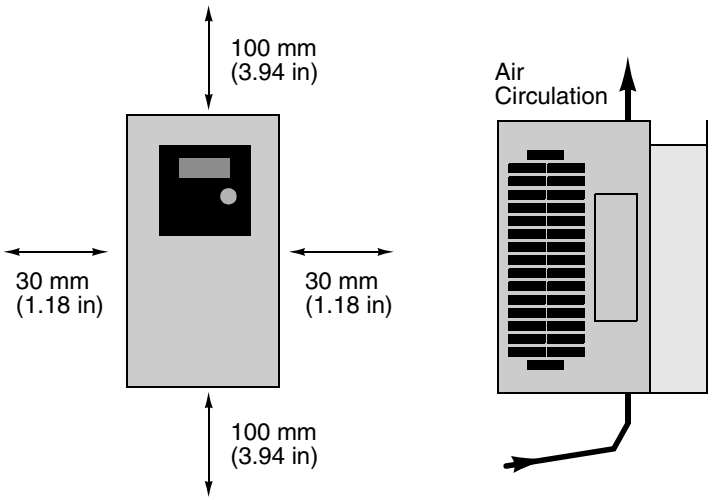
Description	Metric	English
Mounting Torque	1.2 – 1.3 Nm	10.6 – 11.5 lb.in.
Mounting Base Screws	M4 x 0.7	#8-32

- Ensure that debris cover is in place when installing the drive to prevent filings, cable insulation and dust from entering the drive.

Clearances

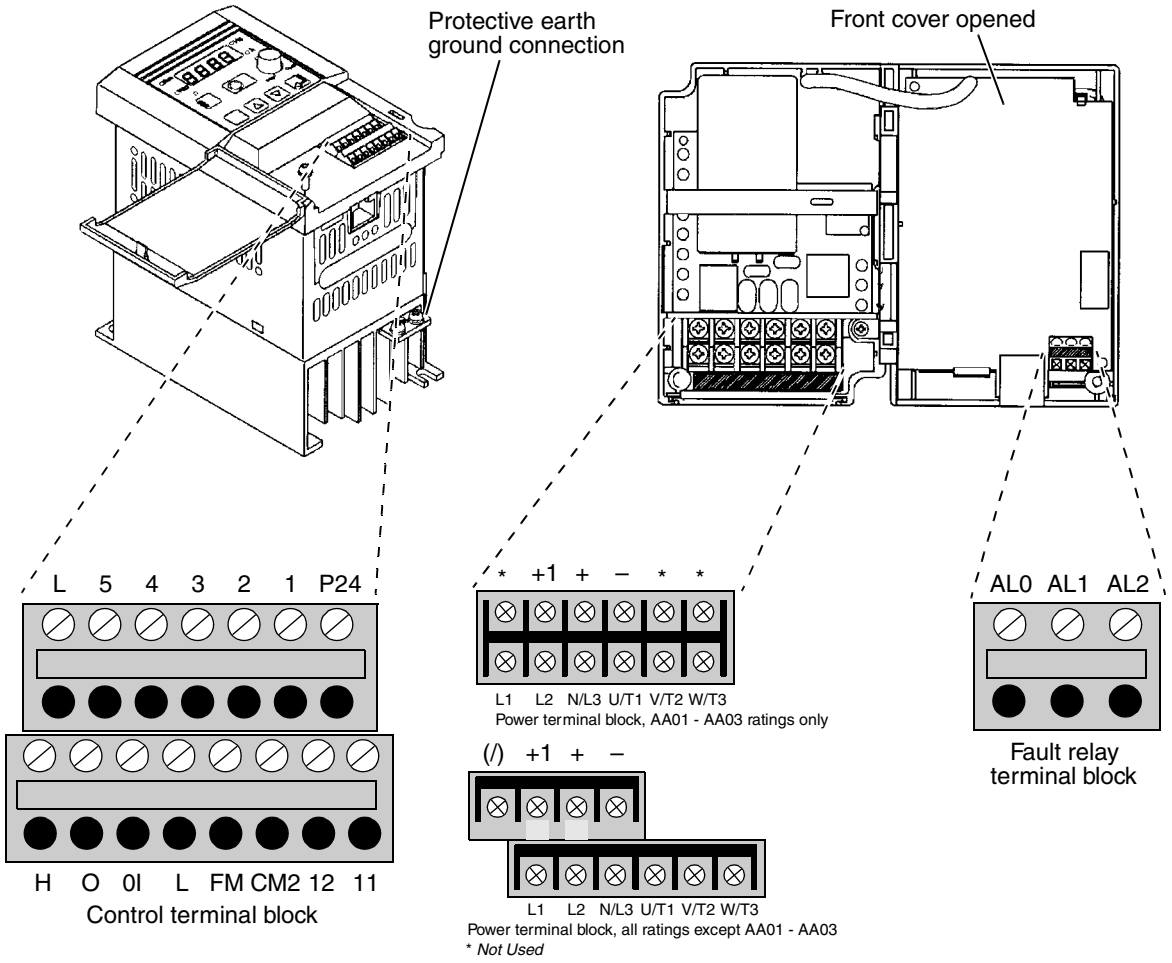
- The drive should be installed using the minimum clearances shown in Figure 2.1.

Figure 2.1 Bulletin 161 Minimum Clearances and Airflow



Terminal Blocks

Figure 2.2 Location of Power, Control, and Fault Relay Terminal Blocks


Protective earth
ground connection
Front cover opened
L 5 4 3 2 1 P24
H O 0I L FM CM2 12 11
Control terminal block
* +1 + – * *
L1 L2 N/L3 U/T1 V/T2 W/T3
Power terminal block, AA01 - AA03 ratings only
(/) +1 + –
L1 L2 N/L3 U/T1 V/T2 W/T3
Power terminal block, all ratings except AA01 - AA03
* Not Used
AL0 AL1 AL2
Fault relay
terminal block

ATTENTION

- **The installation, commissioning and maintenance of these drives may only be carried out by experienced personnel who are thoroughly familiar with the functioning of the equipment and the entire machine.**
- **The devices feature DC-bus capacitors that are energized even when the input supply is switched off. For this reason wait at least 5 minutes after switching off the input supply before you open the device and start working on it. Take care that you do not touch any live parts.**
- **Do not apply input voltage to the output terminals U/T1, V/T2 and W/T3 as drive damage could occur.**
- **Contact the motor or machine manufacturers if standard motors with frequencies greater than 60 Hz will be used in your application.**
- **Failure to follow these precautions could result in severe bodily injury, loss of life or damage to the equipment.**

Power Wiring

Precautions:

> **ATTENTION**
>
> - **Ensure that the input voltage corresponds to the voltage indicated on the product nameplate.**
> - **In normal operation apply the START/STOP commands via the control terminals or the control panel and not by disconnecting and reapplying input power to the drive or motor contactor. If it is necessary to use this method for starting and stopping, or if frequent cycling of power is unavoidable, make certain it does not occur more than once every 5 minutes. Do not install any capacitors or suppressors to the drive output terminals.**
> - **Exercise particular caution if automatic restart is activated. To prevent injuries caused by automatic restarting of the drive following a power failure, install a switching component at the input that is deactivated in the event of a power failure and that may only be manually switched on again on return of the power supply (e.g. contactor etc.).**
> - **Suitable for use on a circuit capable of delivering not more than 5,000 rms symmetrical amperes, 240V maximum.**

Figure 2.3 Power wiring block diagram

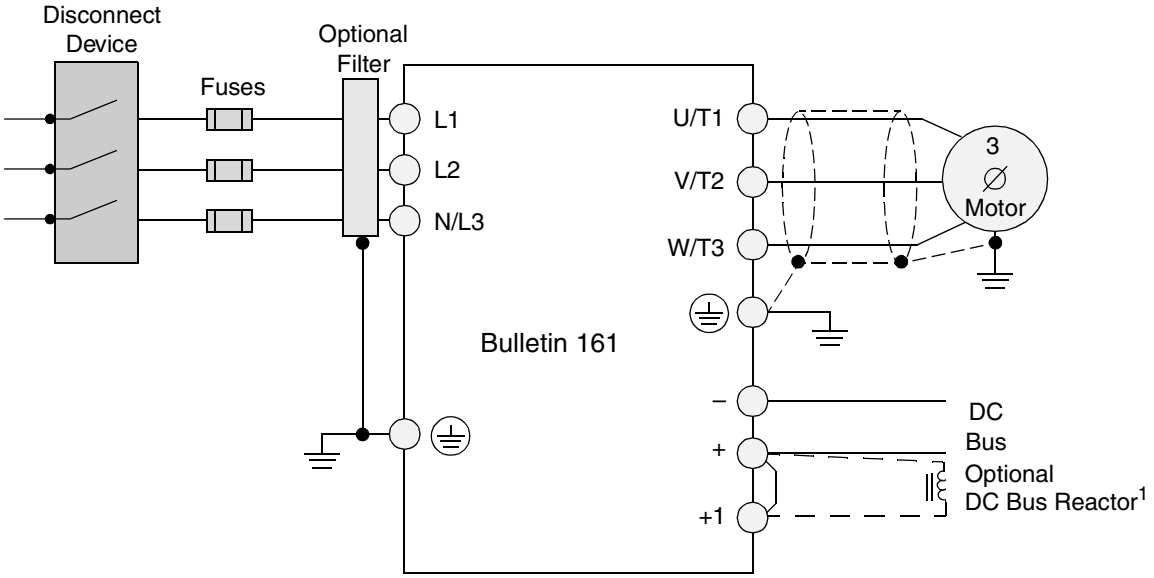
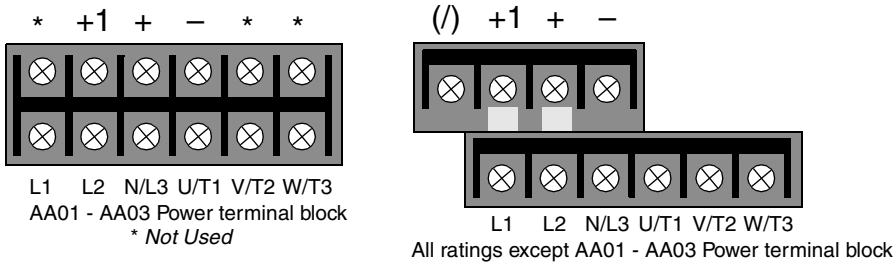


Figure 2.4 Power terminal block descriptions


* +1 + – * *
L1 L2 N/L3 U/T1 V/T2 W/T3
AA01 - AA03 Power terminal block
* Not Used
(/) +1 + –
L1 L2 N/L3 U/T1 V/T2 W/T3
All ratings except AA01 - AA03 Power terminal block

Terminal	Description
L1, L2, N/L3	Connection to incoming power. For single phase input applications, connect the AC input power to input terminals L1 and N/L3
U/T1, V/T2, W/T3	Motor connections
-/+	DC Bus connection
+1 +	These terminals are connected by a jumper. For applications requiring a DC bus reactor, remove the jumper prior to installing the third party device.
⏚	Protective earth ground connection

1 DC Bus Reactor would be used to assist in limiting harmonic distortion from the 161 to the line and reducing capacitive heating due to low impedance lines.

Power Terminal Block Wiring Specifications

Model	Screw Size	Max/Min Wire Size mm^2(AWG)	Max/Min Torque Nm (lbin)
AA01-AA02	M3.5	2.1 – .75 (14-18)	0.9-0.8 (8.0-7.0)
AA03	M3.5	2.1 – 1.3 (14-16)	0.9-0.8 (8.0-7.0)
AA04, DA01	M4	5.3 – 1.3 (10-16)	1.3-1.2 (11.5-10.6)
AA05-AA10, DA02-DA03	M4	5.3 – 2.1 (10-14)	1.3-1.2 (11.5-10.6)
AA15	M4	5.3 – 3.3 (10-12)	1.3-1.2 (11.5-10.6)

Power Terminal Connection

IMPORTANT:

- Bulletin 161 Drives feature an electronic overload protection to monitor the motor current. In the case of multi-motor operation, thermal contacts or PTC resistors must be used for each motor.
- In the case of motor lead lengths greater than 50 meters (165 feet), motor reactors should be used.

Branch Circuit Protection Devices

The following table shows the minimum recommended values for the branch circuit protection devices:

	Fuse Rating (Class CC, J)		Bulletin 140	
Model	**1 Ph**	**3 Ph**	**1 Ph**	**3 Ph**
AA01	10	10	140M-D8N-C10	140M-D8N-B40
AA02-AA03	10	10	140M-D8N-C10	140M-D8N-B63
AA04-AA05	15	15	140M-D8N-C16	140M-D8N-C10
AA07	20	15	140M-D8N-C16	140M-D8N-C16
AA10	30	20	140M-D8N-C25	140M-D8N-C16
AA15	N/A	30	N/A	140M-D8N-C25
DA01	10	N/A	140M-D8N-C10	N/A
DA02	15	N/A	140M-D8N-C10	N/A
DA04	20	N/A	140M-D8N-C16	N/A

Input Power Conditioning

The drive is suitable for connection to input power within the rated voltage of the drive (see specifications). The power factor of the input power supply must not exceed .99. Compensation systems must ensure that over compensation does not occur at any time.

If the drive must be installed in any of the following conditions, an Input Line Reactor must be used:

Input Power Condition	Corrective Action
Line has intermittent noise spikes in excess of 2000V	Install 3% impedance Input Line Reactor
If frequent voltage dips occur	Install 3% impedance Input Line Reactor
The drive is operated on a generator	Install 3% impedance Input Line Reactor
Line has power factor correction capacitors	Install 3% impedance Input Line Reactor
Several drives are linked via a short common power supply bus bar.	Install 3% impedance Input Line Reactor

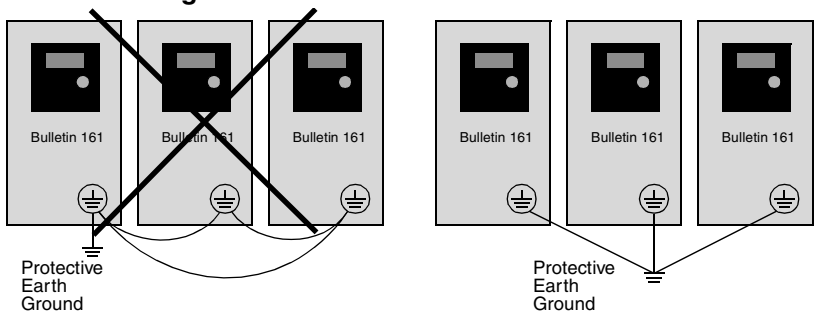
Grounding

ATTENTION

- **The Bulletin 161 has a high leakage current and must be permanently (fixed) hard wired to ground. Failure to observe this precaution could result in severe bodily injury or loss of life.**

Ground the drive. Be sure to separate the drive's grounding pole from those of other electrical machinery. If multiple drives are used, make certain grounding connections do not create a loop as shown in Figure 2.5.

Figure 2.5 Suggested 161 Grounding



Control Wiring

Requirements

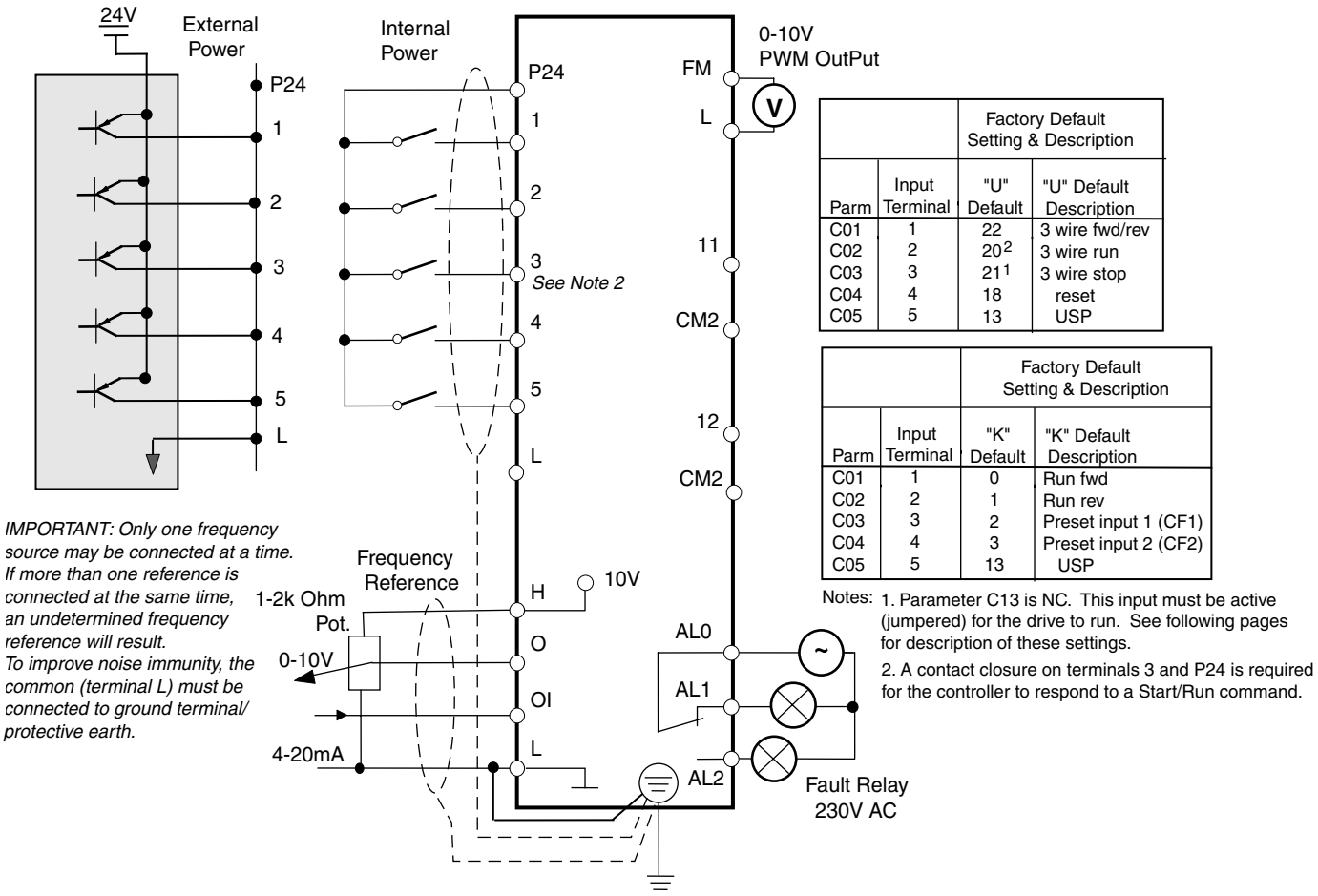
- Run all signal wiring in either a shielded cable or separate metal conduit.
- Do not exceed control wiring length of 20 meters (65.6 feet).
- Use Belden 8760 (or equivalent) –18 AWG (0.750mm^2), twisted pair, shielded or 3 conductor.
- Avoid crossing the power lines or motor lines with the control wires. If they must cross, ensure that they cross at right (90^o) angles.
- If using transistor outputs 11 or 12, with an inductive load such as a relay, install a recovery diode parallel to the relay as shown in Figure 2.6, to prevent damage to the output.

Control Terminal Block Wiring Specifications

Max/Min wire size mm^2 (AWG)	**Max/Min Torque** Nm (in lb)
0.750 – 0.14 (18-28)	0.25 - 0.2 (2.21 – 1.77)

Note: 0.75mm^2 (18 AWG) wire must be used for the alarm relay. Torque the mounting screw to: 0.5-0.6 Nm (4.4-5.3 in lb).

Figure 2.6 Control Wiring Block Diagram



Parm	Input Terminal	Factory Default Setting & Description "U" Default	"U" Default Description
C01	1	22	3 wire fwd/rev
C02	2	20[2]	3 wire run
C03	3	21[1]	3 wire stop
C04	4	18	reset
C05	5	13	USP

Parm	Input Terminal	Factory Default Setting & Description "K" Default	"K" Default Description
C01	1	0	Run fwd
C02	2	1	Run rev
C03	3	2	Preset input 1 (CF1)
C04	4	3	Preset input 2 (CF2)
C05	5	13	USP

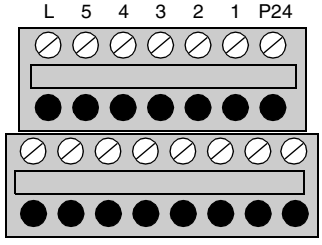
Notes: 1. Parameter C13 is NC. This input must be active (jumpered) for the drive to run. See following pages for description of these settings.

2. A contact closure on terminals 3 and P24 is required for the controller to respond to a Start/Run command.

Figure 2.7 Control terminal block descriptions

ATTENTION

A hazard of electrical shock, death or equipment damage exists. Control terminals are isolated but not tied to earth ground. If terminal (L) on the control terminal block is not grounded, exposed conductors, shields or metal conductors can be at hazardous voltage levels.
Failure to observe this precaution could result in severe injury or loss of life.



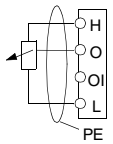
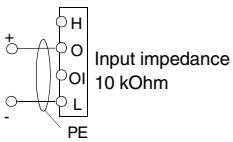
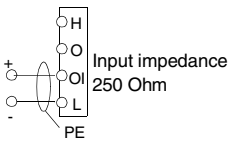
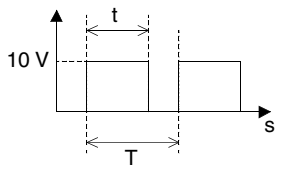
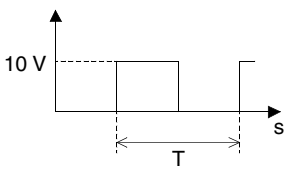
Control Terminal Block

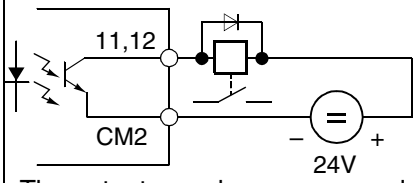
Control Terminal Descriptions

ATTENTION

- **DO NOT jumper or short circuit terminals H and L or P24 and L or drive damage could occur.**

The following table gives a description of each of the terminals on the control terminal block as well as the fault relay:

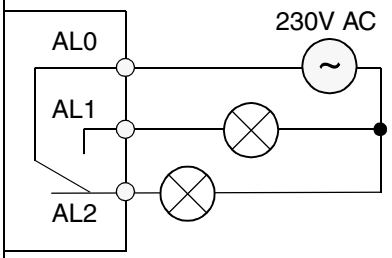
Control Terminal	Function	Description
P24	24 V DC	24 V potential for digital inputs 1-5 max. load 30mA
1 2 3 4 5	Programmable Digital Inputs. 26V max, 5KΩ input impedance.	Digital inputs 1 – 5 are fully programmable level triggered inputs via parameters C01 thru C05. These inputs are level triggered. An overview of the possible functions can be found in the digital input description table in Chapter 2. The inputs are fully programmable with these exceptions: 1. No two inputs can have the same function 2. Only input 5 can be programmed as PTC. 3. With the exception of the reset setting which must be NO (active high), all of the inputs can be set as NO (active high) or NC (active open) via **P**C11-[Digital Input 1 Logic] - **P**C15-[Digital Input 5 Logic]. Note: A signal must be applied to the digital inputs for at least 12 ms
L	0 V	0 V potential for output FM
H	10 V Reference Voltage for Analog Frequency Command	Potentiometer 1 to 2 kOhm  0-9.6 V nominal 0-10 V  4-19.6 mA nominal 0-20 mA  Input OI for 4-20mA is activated when one of the digital inputs is set to 16{AT} via **P**C01-[Digital Input 1] – **P**C05-[Digital Input 5] The analog input reference can be adjusted using **P**A11-[Analog Frequency Minimum] – **P**A16-[Analog Filter Select]. If no digital input is programmed as 16{AT}, the set values are the sum of O and OI.
O	Voltage Analog Input Frequency Command (0-10V)	
OI	Current Analog Input Frequency Command (4-20 mA)	
L	0 V Reference Potential for Frequency Command Inputs	
FM	Programmable Analog Output Analog or Pulse Output Frequency or Motor Current	This output can be used to monitor the output frequency of the drive (either Analog or Pulse) or the motor current. This output is programmable using **P**C23-[Output FM]. Analog Signal Frequency or Current  T=4ms (constant) Pulse Signal (50% duty cycle) Frequency only  T = (Variable) **Analog Signal:** The relation t/T (duty cycle) changes proportionally with the frequency or current. The maximum voltage of 10V (100% duty cycle) is reached when the maximum frequency or 200% of the rated current is reached. **P**b81 - [Output FM Factor] may be used as a scaling factor. Accuracy: +/- 5% for frequency , +/- 20% for current **Pulse Signal:** Frequency = output frequency x **P**b86-[Process Display Scale Factor], but the maximum frequency is 3.6 kHz (ex. Freq = 60Hz x 60 = 3.6kHz).

<table>
<tr><th>Control Terminal</th><th>Function</th><th>Description</th></tr>
<tr><td>CM2</td><td>Reference potential for outputs 11 and 12</td><td rowspan="3">Transistor output, max. 27 Vdc, 50 mA
 

The outputs can be programmed as either NO (active high) or NC (active open) contacts using PC31-[Digital Output 11Logic] and PC32-[Digital Output 12 Logic].

The following 6 settings may be programmed using PC21 - [Digital Output 11] and PC22-[Digital Output 12]:
00{RUN} = Motor Running (Signal if output frequency > 0.5 Hz)
01{FA1} = At frequency (Signal when the set frequency is reached and that frequency is > 0.5Hz)
02{FA2} = Above frequency (Signal if output frequencies ≥ the frequencies set under PC42-[Above Frequency Accel Setting] or PC43-[Above Frequency Decel Setting] and > 0.5 Hz).
03{OL} = Motor overload (Signal if the motor current exceeds the value set under PC41-[Overload Alarm Setting]
04{OD} = PID-deviation (Signal if the deviation between the set value and the actual value returned is greater than the value set under PC44-[PID Deviation Setting]). Only available if the PID control PA71 –[PID Enable] is active.
05{AL} = Fault (Signal if a fault is indicated)</td></tr>
<tr><td>12</td><td>Programmable Digital Output</td></tr>
<tr><td>11</td><td>Programmable Digital Output</td></tr>
<tr><td>AL0

AL1

AL2</td><td>Fault Relay</td><td> 

250 VAC, 2.5 A resistive
0.2A inductive

30 VDC, 3.0A resistive
0.7A inductive

min. 100 VAC, 10mA
5 VDC 100 mA

Faulted / De-energized State

PC33-[Fault Relay AL1 Logic] can be used to invert the operation.

<table>
<tr><th>PC33</th><th>PC33 = 01</th><th>PC33 = 00</th></tr>
<tr><td>AL0 – AL1</td><td>Open when Faulted
Open when Power Off</td><td>Closed when faulted
Open when Power Off</td></tr>
<tr><td>AL0 – AL2</td><td>Closed when Faulted
Closed when power off</td><td>Open when Faulted
Closed when Power Off</td></tr>
</table>
The fault relay is set with a time delay of approximately 2s after the power is switched on.</td></tr>
</table>

Programmable Digital Input (Control terminal block inputs 1 through 5) Functions

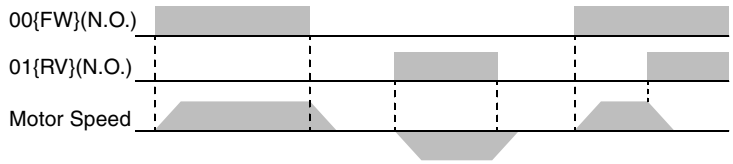
The function of the digital inputs **1** through **5** are programmed via the corresponding **P**C0**1** [Digital Input 1] through **P**C0**5** - [Digital Input 5]. The following programming guidelines must be followed:

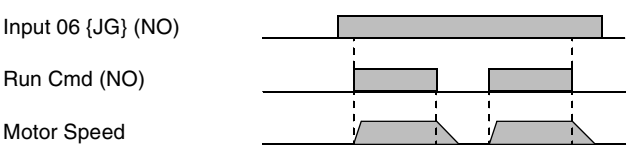
- No two inputs can be programmed for the same function.
- The PTC input (setting 19) is only programmable on input terminal 5.

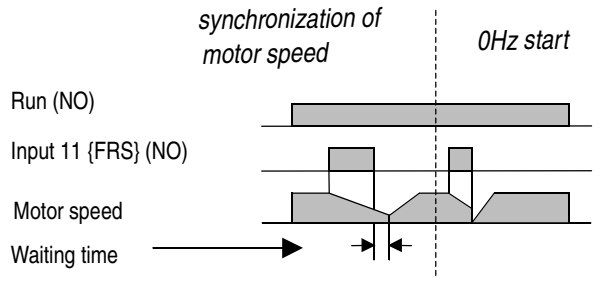
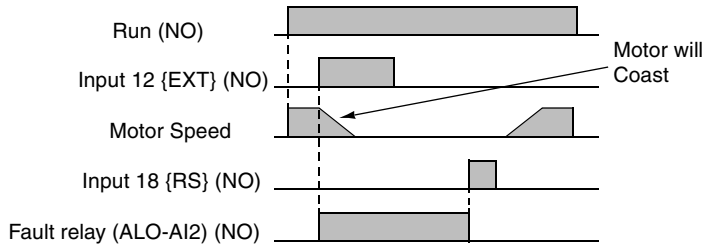
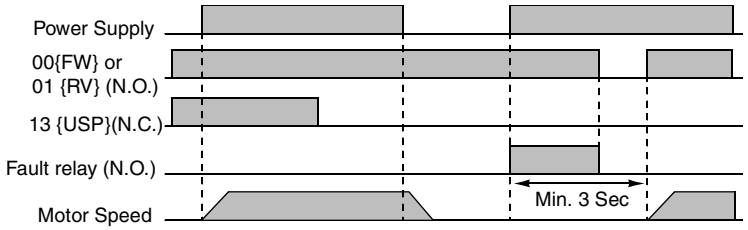
The digital inputs can be programmed to respond to NO (Active High) or NC (Active Open) inputs via **P**C11 - [Digital Input 1 Logic] through **P**C15 - [Digital Input 5 Logic].

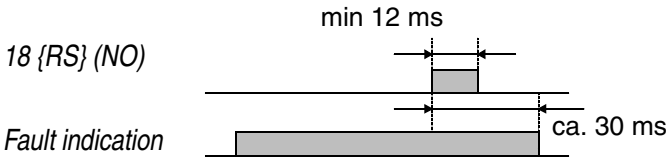
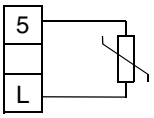
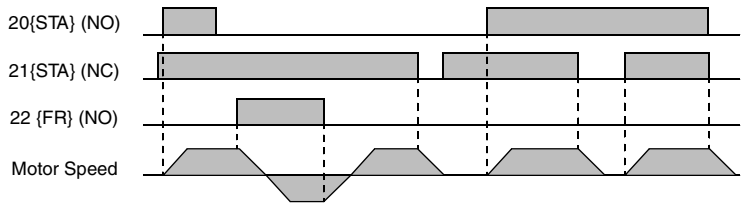
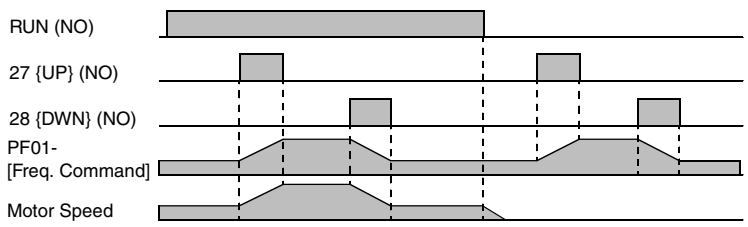
ATTENTION

- All digital inputs respond to level sensitive commands.
- Inputs do not require a voltage transition (cycle) after a fault condition is cleared, after input power cycling or after programming the logic of the digital input.
- All digital inputs can be programmed as NO or NC. HOWEVER, THE **START** COMMAND SHOULD BE SET AS **NO (ACTIVE HIGH)** AND THE **STOP** COMMAND SHOULD BE SET AS **NC (ACTIVE OPEN)**. If set opposite of this, an inadvertent start or failure to stop could occur should a discrete connection be lost or control wire come loose. IF THE USER CHOOSES TO DISREGARD THIS SAFETY PRACTICE – THE RISK ASSUMED BY THE USER CAN BE REDUCED BY ASSURING THAT OTHER SAFEGUARDS ARE USED TO INSURE PROPER START AND STOP OPERATION. Depending on the application: This may include appropriate emergency stops, redundant wiring, electronic guards and/or mechanical guards.
  Failure to observe this precaution could result in severe bodily injury or loss of life.

<table>
<tr><th>C01 - C05 Setting</th><th>Alpha Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>00</td><td>{FW}</td><td>Forward</td><td rowspan="2">2-Wire (maintained) Run Forward/Run Reverse settings.
 
</td></tr>
<tr><td>01</td><td>{RV}</td><td>Reverse</td></tr>
<tr><td>02</td><td>{CF1}</td><td>Preset frequency input</td><td rowspan="3">The preset frequencies may be programmed in two ways:
1. By programming desired preset frequency values via PA21-[Preset Frequency 1] through PA35-[Preset Frequency 15].
2. By selecting the corresponding digital input setting and entering the desired frequency via PF01-[Frequency Command].

<table>
<tr><th rowspan="2">Setting</th><th rowspan="2">Input</th><th colspan="16">Preset Speed</th></tr>
<tr><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>9</th><th>10</th><th>11</th><th>12</th><th>13</th><th>14</th><th>15</th></tr>
<tr><td>02</td><td>CF1</td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td><td></td><td>ON</td></tr>
<tr><td>03</td><td>CF2</td><td></td><td>ON</td><td>ON</td><td></td><td></td><td>ON</td><td>ON</td><td></td><td></td><td>ON</td><td>ON</td><td></td><td></td><td>ON</td><td>ON</td></tr>
<tr><td>04</td><td>CF3</td><td></td><td></td><td></td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td></td><td></td><td></td><td></td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
<tr><td>05</td><td>CF4</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr>
</table>
Note: If any preset frequency input is active, all other frequency commands will be ignored.</td></tr>
<tr><td>03</td><td>{CF2}</td><td>Preset frequency input</td></tr>
<tr><td>04</td><td>{CF3}</td><td>Preset frequency input</td></tr>
<tr><td>05</td><td>{CF4}</td><td>Preset frequency input</td></tr>
<tr><td>06</td><td>{JG}</td><td>Jog</td><td>When this input is active, the 00{FW} or 01{RV} inputs will respond to the frequency programmed via PA38-[Jog Frequency]. The accel ramp is NOT active.
The stop command is determined by PA39-[Jog Stop Mode].
Note: The Jog command will not work with 3-wire control.
 
</td></tr>
<tr><td>09</td><td>{2CH}</td><td>2nd Accel/Decel ramp</td><td>2nd Accel/Decel ramp times are activated via this input and programmed via PA92-[Accel Time 2] and PA93-[Decel Time 2].</td></tr>
</table>

C01 - C05 Setting	Alpha Setting	Function	Description
11	{FRS}	Coast to Stop	The motor voltage will be switched off immediately and the motor will coast. This function can be programmed to operate in two different modes via **P**b88-[FRS Select].  *Note: The drive will start when 11 {FRS} input is removed without reissuing a start command even if in 3 wire (momentary) control.*
12	{EXT}	External Fault	When this input is active, an E12 fault indication will be issued (e.g. an input received from thermal contacts). The fault indication will be cleared with a reset 18{RS}. **Important**: After a reset 18{RS} command, the drive will start again if a start command is active (00{FW}, 01{RV},or 20{STA}). 
13	{USP}	Unintentional Start Protection on Power Up	This function is designed to guard against unintended starting when input power is removed and then restored. In this case, if a start/run command is issued immediately upon/after power is restored an E13 fault will be issued. A new start command or a reset 18{RS} command will clear the fault indication. 
15	{SFT}	Program Lock	Protects stored parameter values from being overwritten. See **P**b31-[Program Lock Select] for the 4 different levels of protection.
16	{AT}	4-20mA Select	Activates input terminal OI for use as a 4-20mA input. If no input terminal is programmed for this setting, the factory default input is O (0-10V) and the output frequency will correspond to the value of the inputs to the O and/or OI control inputs. *Note: **P**A01-[Frequency Command Select] determines from what source the output frequency is commanded.*

<table>
<tr><th>C01 - C05 Setting</th><th>Alpha Setting</th><th>Function</th><th>Description</th></tr>
<tr><td>18</td><td>{RS}</td><td>Reset</td><td>Used to clear a fault condition. If a 18 {RS} command is given during operation, the output IGBT's are switched off and the motor will coast.
 
</td></tr>
<tr><td>19</td><td>{PTC}</td><td>PTC Input</td><td>This input can only be programmed to digital input terminal 5 and the PTC should be referenced to terminal L.
If the PTC resistance exceeds 3k Ohms the output voltage to the motor will be switched off and an E35 fault code will be issued.
 
</td></tr>
<tr><td>20</td><td>{STA}</td><td>3 wire run</td><td rowspan="3">3-Wire (Momentary) control inputs. Both settings 20 {STA} and 21 {STP} must be programmed as digital inputs for 3-wire control to function. If 20 {STA} is programmed into any digital input then 2-wire (maintained) control will not function.
Note: 3-wire stop command (21 {STP}) cannot be used to clear a fault.
 
</td></tr>
<tr><td>21</td><td>{STP}</td><td>3 wire stop</td></tr>
<tr><td>22</td><td>{F/R}</td><td>3 wire Forward/ Reverse</td></tr>
<tr><td>27</td><td>{UP}</td><td>Remote Control UP</td><td rowspan="2">These settings allow digital inputs to increase and decrease the commanded frequency for the drive. PA01-[Frequency Command Select] must be set to 02 to activate this function. These inputs will change the value of PF01-[Frequency Command] in Hz/Sec as defined by PA04-[Maximum Frequency] ÷ (Accel time or Decel time).
 
</td></tr>
<tr><td>28</td><td>{DWN}</td><td>Remote Control DOWN</td></tr>
<tr><td>31</td><td>{OPE}</td><td>Run Command Source Select</td><td>This setting is used to determine the source of the Run commands.
<table><tr><td>Inactive</td><td>Start command will come from the control terminals only, regardless of the setting of PA02 - [Start Command Select]</td></tr><tr><td>Active</td><td>Start command will come from the start key on the keypad only regardless of the setting of PA02 - [Start Command Select]</td></tr></table></td></tr>
</table>

Chapter 3 – Parameters & Programming

ATTENTION

Wait at least 6 seconds after programming the Bulletin 161 before issuing a start, reset command, or switching off the power supply. Failure to wait 6 seconds, could result in failure to recognize programming changes, which could lead to bodily injury or damage to the equipment.

Programming Keypad

The keypad is located on the front panel of the drive. This is an integrated keypad that can be used to monitor drive operation, program parameters, and operate the drive. See page 17 for details on controlling the start, stop & speed reference from the keypad.

Keypad Features

Keypad Functions	
SEL	The **SELect key** is a dual purpose key. It is used to view parameter groups and to switch between parameter numbers and values. The SELect key also acts as an Escape key to exit the parameter values without changing them.
▲ ▼	The **Up/Down Arrow keys** are used to scroll through parameters, or to increase and decrease parameter values.
↵	The **ENTER key** is used to enter the current value into memory.
I	The **Start key** can be activated using **P**A02-[Start Command Select] or digital input setting 31{OPE}. When active, the key will start the motor in the direction of rotation defined in **P**F04-[Start Key Direction]. **NOTE:** If the drive is set for 3 wire control (**C**03 set to 21), the Stop Input must be jumpered for the drive to run.
Min Max	The **Speed Potentiometer** can be used to set the commanded frequency. This can be activated using **P**A01-[Frequency Command Select].
O	The **Stop key** is used to stop the motor. If the drive has stopped due to a fault, pressing this key will clear the fault.

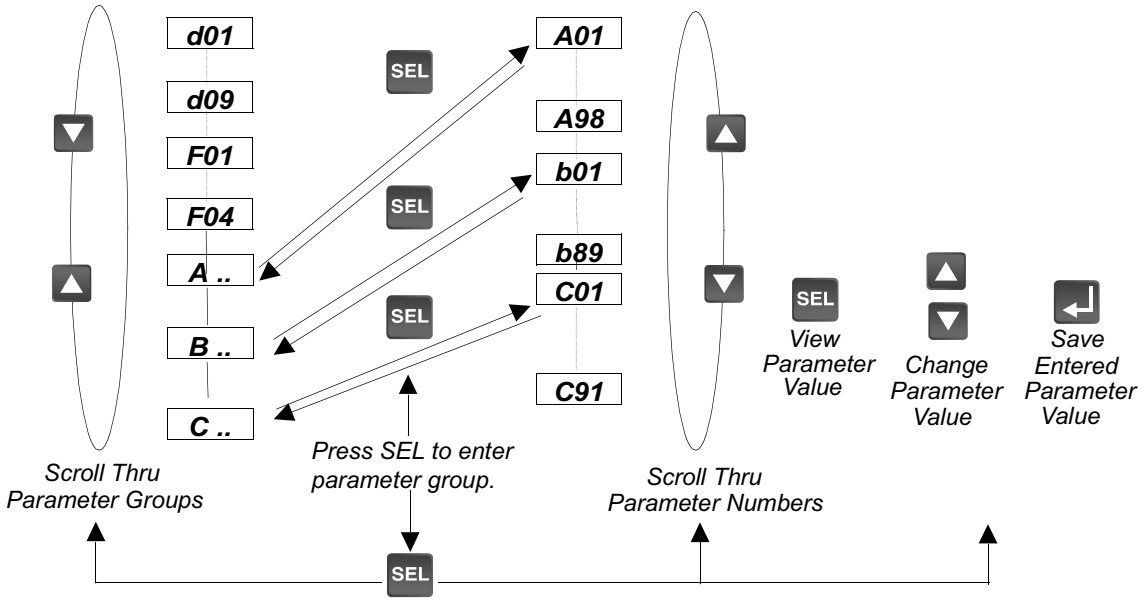
Other Functions
The **PRG LED** will be lit when a programmable parameter is displayed.
The **Hz** and **A** LEDs are used to inform you whether Hz or Amps are being displayed.
The **RUN LED** will be lit when the drive is in operation.
The **Start Key** and **Speed Pot LED's** are green LED's which will light when the item is active.

ATTENTION: If the Stop Key is used to clear a fault and there is a valid run command, the drive will start to run as soon as the fault is cleared without cycling the run input. Failure to observe this precaution could result in severe bodily injury.

Figure 3.1 Operator Interface

Programming Keypad

Figure 3.2 Programming Guide



Programming Examples

In this section you will find four different programming examples to help you program the 161 drive.

Initial Power Up

This example shows you how to proceed from the power up parameter value to the actual parameter number.

Action	Description	Display
	1. Apply power to the Drive *Note: If you were viewing a display parameter when power was last removed from the drive, the same display parameter value will reappear when the drive is re-powered. If you were viewing any other parameter value when power was removed, the parameter group or parameter number will appear when the drive is re-powered.*	*0.0*
SEL	2. Press the SELect Key to switch from the parameter value to the parameter number.	*d 01*

Scrolling through parameter groups

This example will show you how to check a parameter value without changing the value of the parameter. For this example, the operation of **P**C21 - [Digital Output 11] will be verified.

Action	Description	Display
▲ ▼	3. Press the Up/Down keys to scroll through the parameter groups, stopping at the **C** group. *Note: You must scroll thru all of the **d** and **F** group parameters, but the **A**, **b**, and **C** parameters are grouped and the group must be SELected to view the parameters within that specified group. Figure 3.3 contains a hierarchy which details which parameters are in each group.*	*C - -*
SEL	4. Press the SELect Key to enter into the **C** group. **P**C01 - [Digital Input 1] should appear on the display. *Note: When parameter groups are entered, the number of the parameter that was being viewed when you last exited the group will be displayed.*	*C 01*
▲	5. Press the Up Key to scroll through the parameters contained within the group, continue pressing the Up Key until **P**C21 - [Digital Output 11] is displayed. ***Note:** When viewing parameters within the **A**, **b** and **C** groups the parameters will wrap from A01 through C91 by pressing the Up/Down Keys. To view parameters within the **d** and **F** groups the SELect Key must be pressed until the display shows **A - -**, **b - -** or **C- -**. Once the group letter is displayed, the Up/Down Key will scroll to the **d** and **F** parameters.*	*C 21*

Action	Description	Display
SEL	6. Press the SELect Key to view the parameter value stored in **P**C21 - [Digital Output 11].	*01*
SEL	7. Press the SELect Key again to exit from the parameter value back to the parameter number without changing the stored value.	*C 21*
SEL	8. Press the SELect Key again to exit from the parameter number to the parameter group display.	*C - -*

Operation of the Drive via the Fixed Keypad

The following steps demonstrate configuring the drive for operation from the keypad.

Activate the Start Key on the Keypad.

Action	Description	Display
SEL	9. Press the SELect Key to switch from the parameter value to the parameter number.	*d 01*
▲ ▼	10. Press the Up/Down Keys to scroll through the parameter groups stopping at the **A** group.	*A --*
SEL	11. Press the SELect Key to enter into the **A** group.	*A 01*
▲	12. Press the Up Key to display **PA**02 - [Start Command Select].	*A02*
SEL	13. Press the SELect Key to view the parameter value stored in parameter **A**02 - [Start Command Select].	*01*
▲	14. Use the Up Key to change the value of **PA**02 - [Start Command Select] from the default value of 01 to 02. This will switch the source of the start input from the control terminal block to the keypad.	*02*
↵	15. When the desired value is displayed, press the Enter Key. This writes the new value to memory and the display will return to the parameter number. ***Note:*** *The green LED above the Start key will be illuminated when the Start key is active.*	*A02*

Note: The factory default settings for the “U” version drive is three wire control (**PC**03 is set to 21 and **C**13 is set to 01). A jumper is required between terminals P24 and 3 on the control terminal block for the drive to run.

Note: The direction of rotation is controlled by **PF**04 - [Start Key Direction]. Refer to page 22 of the User Manual for parameter setting options.

Activating the Speed Pot on the Keypad

Parameter **A**01-[Frequency Command Select] is used to select the source of the frequency command.

Action	Description	Display
▼	16. Press the Down Key until **PA**01 - [Frequency Command Select] is displayed.	*A01*
SEL	17. Press the SELect key to view the parameter value.	*01*
▼	18. Use the Down Key to change the value of **PA**01 - [Frequency Command Select] from the default value of 01 to 00. This will switch the source of the frequency command to the potentiometer on the keypad.	*00*
↵	19. When the desired value is displayed, press the Enter Key. This writes the new value to memory and the display will return to the parameter number.	*A01*

Note: The output frequency of the Bulletin 161 can also be controlled digitally from the keypad by setting **PA**01 to setting 02, then using **PF**01-[Frequency Command] to change to output frequency of the drive.

Note: If a digital input is set as 27 (UP) or 28 (DWN), when activated these inputs will also change the frequency of the drive.

Restoring Factory Defaults

This example will show you how to reset the factory defaults of the drive.

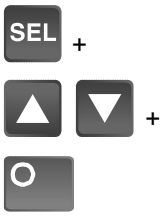
Action	Description	Display
	20. Press the Down Key to advance to the **b** parameter group.	*b - -*
	21. Press the SELect key to enter into the **b** parameter group.	*b 01*
	22. Press the Up Key to scroll through the parameters until parameter **b**84 - [Reset Functions] is displayed.	*b 84*
	23. Press the SELect Key to view the parameter value stored in parameter **b**84 - [Reset Functions] and verify that it is set to 01. If it is not 01, use the UP key to change the value to 01, then press the Enter key. *Note: The defaults will be reset to the values determined by parameter **b**85 - Factory Default Select].*	*01*
	24. Press the SELect Key to exit the parameter value back to the parameter number without changing the stored value.	*b 84*
	25. Press and hold the SELect, Up, Down and Stop Keys for 3 seconds. NOTE: The keys can be pressed and held in any sequence, but the Stop Key MUST be the last key held.	*b 84*
	26. Release the Stop Key and continue to hold the SELect, Up and Down Keys until the display begins to blink. Release the remaining keys. When this is done, 0.0 will be displayed (this is parameter **d**01 - [Output Frequency]).	*00* "Blinking" *0.0*

Figure 3.3 Parameter Groups

Parameter Tree

d group - Display and Diagnostic Parameters (Read only)

- Display & Diagnostic Functions
  - d01 Output Frequency
  - d02 Output Current
  - d03 Direction
  - d04 PID Process Display
  - d05 Digital Input Status
  - d06 Output Status
  - d07 Process Display
  - d08 Last Fault
  - d09 Fault Register
  - d16 Elapsed Run Time

F group - Basic Function Parameters

- Basic Functions
  - F01 Frequency Command
  - F02 Accel Time 1
  - F03 Decel Time 1
  - F04 Start Key Direction

A group - Advanced Function Parameters

- Basic Functions
  - A01 Frequency Command Select
  - A02 Start Command Select
  - A03 Base Frequency
  - A04 Maximum Frequency
- Analog Input Reference Adjustment
  - A11 Analog Frequency Minimum
  - A12 Analog Frequency Maximum
  - A13 Analog Input Minimum
  - A14 Analog Input Maximum
  - A15 Analog Start Select
  - A16 Analog Filter Select
- Preset Frequencies
  - A20 Internal Frequency
  - A21 Preset Frequency 1
  - A22 Preset Frequency 2
  - A23 Preset Frequency 3
  - A24 Preset Frequency 4
  - A25 Preset Frequency 5
  - A26 Preset Frequency 6
  - A27 Preset Frequency 7
  - A28 Preset Frequency 8
  - A29 Preset Frequency 9
  - A30 Preset Frequency 10
  - A31 Preset Frequency 11
  - A32 Preset Frequency 12
  - A33 Preset Frequency 13
  - A34 Preset Frequency 14
  - A35 Preset Frequency 15
  - A38 Jog Frequency
  - A39 Jog Stop Mode
- V/F Characteristics/Boost
  - A41 Boost Select
  - A42 Manual Boost Voltage
  - A43 Manual Boost Frequency
  - A44 V/Hz Select
  - A45 Maximum Voltage
- DC Brake
  - A51 DC Brake Select
  - A52 DC Brake Start Frequency
  - A53 DC Wait Time
  - A54 DC Hold Voltage
  - A55 DC Hold Time
- Operating Frequency Range
  - A61 Upper Frequency Limit
  - A62 Minimum Frequency
  - A63 Skip Frequency 1
  - A64 Skip Frequency Band 1
  - A65 Skip Frequency 2
  - A66 Skip Frequency Band 2
  - A67 Skip Frequency 3
  - A68 Skip Frequency Band 3
- PID Controller
  - A71 PID Enable
  - A72 PID Proportional Gain
  - A73 PID Integral Gain
  - A74 PID Differential Gain
  - A75 Process Reference Scale Factor
  - A76 Analog Feedback Select
- Automatic Voltage Regulation
  - A81 AVR Function Select
  - A82 Base Voltage
- Second Acceleration/Deceleration Ramp
  - A92 Accel Time 2
  - A93 Decel Time 2
  - A94 Accel/Decel 2 Select
  - A95 Accel 2 Start Frequency
  - A96 Decel 2 Start Frequency
  - A97 Accel Curve
  - A98 Decel Curve

Parameter Tree cont.

b Group - Advanced Control and Protection

- Automatic Start After a Fault
  - b01 Restart Mode Select
  - b02 Power Loss Time
  - b03 Restart Time
- Electronic Motor Protection
  - b12 Motor Overload Current
  - b13 Motor Overload Select
- Current Limit
  - b21 Current Limit Select
  - b22 Current Limit
  - b23 Current Limit Decel Time
- Parameter Protection
  - b31 Program Lock Select
- Current Feedback Tuning
  - b32 Relative Current Setting
- Initialization/Adjustment Function
  - b81 Output FM Adjustment
  - b82 Start Frequency
  - b83 PWM Frequency
  - b84 Reset Functions
  - b85 Factory Default Select
  - b86 Process Display Scale Factor
  - b87 STOP Key select
  - b88 FRS Select
  - b89 Keypad Display
  - b92 Reserved

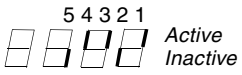
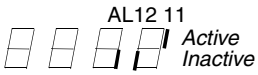
C group - Intelligent I/O and Communication

- Digital Inputs 1-5
  - C01 Digital Input 1
  - C02 Digital Input 2
  - C03 Digital Input 3
  - C04 Digital Input 4
  - C05 Digital Input 5
  - C11 Digital Input 1 Logic
  - C12 Digital Input 2 Logic
  - C13 Digital Input 3 Logic
  - C14 Digital Input 4 Logic
  - C15 Digital Input 5 Logic
- Outputs 11, 12, FM, AL0 - AL1
  - C21 Digital Output 11
  - C22 Digital Output 12
  - C23 Output FM Select
  - C31 Digital Output 11 Logic
  - C32 Digital Output 12 Logic
  - C33 Fault Relay AL1 Logic
  - C41 Overload Alarm Threshold
  - C42 Above Frequency Accel Threshold
  - C43 Above Frequency Decel Threshold
  - C44 PID Deviation Threshold
- Communications
  - C70 Communication Command Select
  - C71 Unassigned
  - C72 Unassigned
  - C79 Communication Error Select
  - C91 Debug Mode

Parameter Descriptions

D Group - Display and Diagnostic Parameters (Read Only)

This group of parameters consists of commonly viewed drive operation conditions such as output frequency. All parameters in this group are Read Only.

Parameter Number	Parameter Name / Description	Min./Max Range	Units
Display and Diagnostic Functions			
d01	**[Output Frequency]** Displays the output frequency to the motor.	0.0/360.0	0.1 Hz
d02	**[Output Current]** Displays the output current to the motor.	0.00/ 999.9	0.01A
d03	**[Direction]** Displays the present direction of rotation. F=Forward r=Reverse o=Stop	Alpha Numeric Value	Alpha Numeric Value
d04	**[PID Process Display]** Displays the scaled PID Process variable (feedback), this is only available when the PID control is active. The scale factor is set using parameter **C**15 - [Digital Input 5 Logic].	0/100.0	0.01%
d05	**[Digital Input Status]** Displays the status of the 5 digital inputs regardless of how each input is programmed in parameter **C**11 - [Digital Input 1 Logic] through parameter **C**15 - [Digital Input 5 Logic].  5 4 3 2 1 *Active* *Inactive*	N/A	N/A
d06	**[Output Status]** Displays the status of the digital outputs and the fault indication relays.  AL12 11 *Active* *Inactive*	N/A	N/A
d07	**[Process Display]** Displays parameter **d**01 - [Output Frequency] scaled by the variable set in parameter **b**86 - [Process Display Scale Factor]. *Note: If there are more than 4 digits, the LSB will be dropped.*	0.00/9999	0.01
d08	**[Last Fault]** Displays the last fault. The output frequency, motor current, and DC-bus voltage at the time of the last fault can be viewed by pressing the SELect key. If there has not been a fault or the register has been cleared, then --- will be displayed.	N/A	---
d09	**[Fault Register]** Displays the 2nd and 3rd fault, if there are no faults stored in this register, then --- will be displayed. To view the 3rd fault, press the SELect key.	N/A	---
d16	**[Elapsed Run Time]** Displays the elapsed running time of the drive. The elapsed running time is the displayed value x 10.	0/9999	10 hours

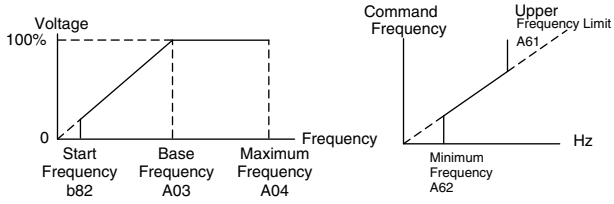
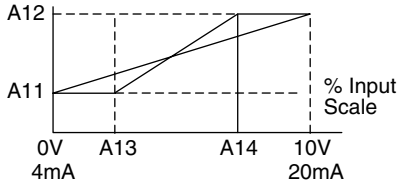
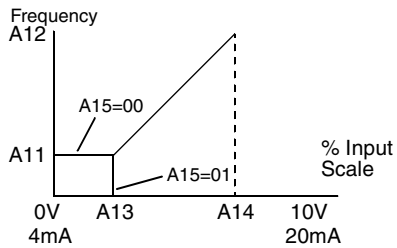
F Group – Basic Function Parameters

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Basic Functions				**U[1]**	**K[1]**
F01	**[Frequency Command]** When parameter **A**01- [Frequency Command Select] is set to 00 or 01, this parameter will display the commanded frequency. When **P**A01 - [Frequency Command Select] is set to 02, this parameter can be used to change the commanded frequency on the fly and write the value into parameter **A**20 - [Internal Frequency]. When a preset frequency is active, this parameter can be used to program or change the value of the preset input on the fly while writing the value into the corresponding parameter (**P**A21 - [Preset Frequency 1] – **P**A35 - [Preset Frequency 15]). *Note: The value Is changed in real time and written to memory without using the Enter key.* *This parameter **can** be changed while motor is running.*	0.0/360.0	0.1 Hz	N/A	N/A
F02	**[Accel Time 1]** Time for the drive to ramp from 0.0 Hz to **P**A04 - [Maximum Frequency] *This parameter **can** be changed while motor is running.*	0.1/3000	<1000, 0.1 s >1000, 1 s	10.0	10.0
F03	**[Decel Time 1]** Time for the drive to ramp from **P**A04 - [Maximum Frequency] to 0.0 Hz *This parameter **can** be changed while motor is running.*	0.1/3000	<1000, 0.1 s >1000, 1 s	10.0	10.0
F04	**[Start Key Direction]** Sets the direction of motor rotation when the drive is set to Start Key mode, which is controlled by **P**A02 - [Start Command Select] and digital input setting 31 {OPE}. Settings: 00=Forward 01=Reverse 02=Control Terminal – Digital inputs (C01-C05) settings 00 {FW} and 01 {RV} determine direction of Start Key.	00/02	Numeric Value	00	0.0

A Group – Advanced Function Parameters

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Basic Functions				**U[1]**	**K[1]**
A01	**[Frequency Command Select]** Selects the source of the frequency command for the drive. *Note: If any preset frequency inputs are active, all other frequency commands will be ignored.* Settings: 00= Keypad frequency potentiometer 01=Input O/OI (Analog reference) 02=Internal frequency (**P**F01 - [Frequency Command]/ **P**A20 - [Internal Frequency])	00/02	Numeric Value	01	01
A02	**[Start Command Select]** Selects the source of the start command. Settings: 01=Control terminal block 02=Start Key (Input from Start Key on drive keypad) ***Note:** If **P**C03 is set to 21, terminals P24 and 3 must be jumpered for drive to run.*	01/02	Numeric Value	01	01

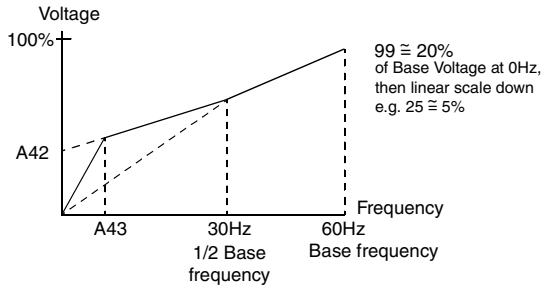
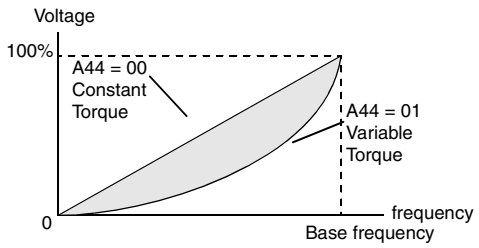
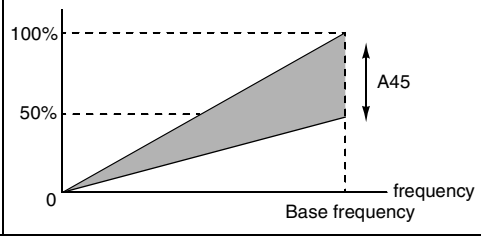
[1] U = 50Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Basic Functions				**U[1]**	**K[1]**
A03	**[Base Frequency]** Set value to rated nameplate frequency of motor 	50/360	1 Hz	60	50
A04	**[Maximum Frequency]** Highest frequency the drive will output. *Note: If a maximum frequency less than **P**A03 – [Base Frequency] is needed, use **P**A61 – [Upper Frequency Limit].* *Refer to diagram in **P**A03 – [Base Frequency].*	50/360	1Hz	60	50
Analog input reference adjustment				**U[1]**	**K[1]**
A11	**[Analog Frequency Minimum]** Sets the frequency that corresponds to a 0V or 4mA analog signal. 	0.0/360.0	0.1 Hz	0.0	0.0
A12	**[Analog Frequency Maximum]** Sets the frequency that corresponds to a 10V or 20mA analog signal. A value of 0.0 will disable this function. *Refer to diagram in **P**A11 – [Analog Frequency Minimum].*	0.0/360.0	0.1 Hz	0.0	0.0
A13	**[Analog Input Minimum]** Sets the starting point (offset) for the analog input range. *Refer to diagram in **P**A11 - [Analog Frequency Minimum]*	0/99	1%	0	0
A14	**[Analog Input Maximum]** The ending point (offset) for the analog input range. *Refer to diagram in **P**A11 - [Analog Frequency Minimum].*	0/100	1%	100	100
A15	[**Analog Start Select]** Sets the output frequency when frequency reference is below value set in **P**A13 – [Analog Input Minimum]. Settings: 00 = **P**A11 - [Analog Frequency Minimum] 01 = 0 Hz 	00/01	Numeric Value	01	01
A16	**[Analog Filter Select]** Sets the level of the Analog input smoothing filter where: 1 = low. (Bandwidth = 200 Hz) 8 = high. (Bandwidth = 25 Hz)	1/8	Numeric Value	8	8

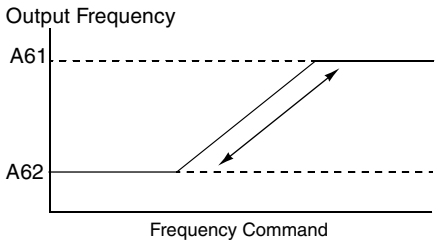
[1] U = 50Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Parameter Number	Parameter Name / Description		Min./Max Range	Units	Factory Defaults	
Pre-Set Frequencies					**U[1]**	**K[1]**
A20	**[Internal Frequency]** When **P**A01-[Frequency Command Select] is set to 02, this parameter will provide the drives frequency command. This parameter will change the frequency command only after the new frequency is entered into memory. This value can also be changed via **P**F01 - [Frequency Command] if no preset frequency inputs are active. *This Parameter **can** be changed while motor is running.*		0.0/360.0	0.1 Hz	60.0	0.0
A21	**[Preset Frequency 1]**	The programmed value sets the frequency that the drive outputs when selected. (Refer to digital input settings table in Chapter 2). *Note: If a preset frequency input is active, the keypad frequency pot and analog frequency commands will be ignored. Note: The value of any Preset Frequency can be changed via **P**F01 - [Frequency Command] when the Preset Frequency is activated via the digital inputs. These Parameters **can** be changed while motor is running.*	0.0/360.0	0.1 Hz	0.0	0.0
A22	**[Preset Frequency 2]**		0.0/360.0	0.1 Hz	3.0	0.0
A23	**[Preset Frequency 3]**		0.0/360.0	0.1 Hz	5.0	0.0
A24	**[Preset Frequency 4]**		0.0/360.0	0.1 Hz	10.0	0.0
A25	**[Preset Frequency 5]**		0.0/360.0	0.1 Hz	15.0	0.0
A26	**[Preset Frequency 6]**		0.0/360.0	0.1 Hz	20.0	0.0
A27	**[Preset Frequency 7]**		0.0/360.0	0.1 Hz	25.0	0.0
A28	**[Preset Frequency 8]**		0.0/360.0	0.1 Hz	30.0	0.0
A29	**[Preset Frequency 9]**		0.0/360.0	0.1 Hz	35.0	0.0
A30	**[Preset Frequency 10]**		0.0/360.0	0.1 Hz	40.0	0.0
A31	**[Preset Frequency 11]**		0.0/360.0	0.1 Hz	45.0	0.0
A32	**[Preset Frequency 12]**		0.0/360.0	0.1 Hz	50.0	0.0
A33	**[Preset Frequency 13]**		0.0/360.0	0.1 Hz	55.0	0.0
A34	**[Preset Frequency 14]**		0.0/360.0	0.1 Hz	60.0	0.0
A35	**[Preset Frequency 15]**		0.0/360.0	0.1 Hz	0.0	0.0
A38	**[Jog Frequency]** This parameter sets the frequency the drive will output when it receives a valid jog command. *This Parameter **can** be changed while motor is running.*		0.5/9.9	0.1 Hz	5.0	5.0
A39	**[Jog Stop Mode]** This parameter sets the stop method when the jog input is removed. Settings: 00=Coast 01=Ramp 02=DC Brake (See **P**A53 - [DC Wait Time] – **P**A55 - [DC Hold Time])		00/02	Numeric Value	01	01

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using Pb85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
V/F Characteristics / Boost				**U[1]**	**K[1]**
A41	**[Boost Select]** Used to select auto or manual boost Settings: 00=Manual Boost 01=Auto Boost	00/01	Numeric Value	00	00
A42	**[Manual Boost Voltage]** Sets the boost level as a percent of **P**A82 - [Base Voltage]. *This Parameter **can** be changed while motor is running.* 	0/99	Numeric Value	25	11
A43	**[Manual Boost Frequency]** Sets the boost frequency point as a percent of **P**A03 - [Base Frequency]. Refer to diagram in **P**A42 – [Manual Boost Voltage] *This Parameter **can** be changed while motor is running.*	0.0/50.0%	0.1%	2.0	10.0
A44	**[V/Hz Select]** Used to select the V/Hz mode. Settings: 00=Constant Torque 01=Variable Torque 	00/01	Numeric Value	00	00
A45	**[Maximum Voltage Gain]** Sets the voltage gain of the V/Hz characteristic. Value is a percent of **P**A82 - [Base Voltage]. *This Parameter **can** be changed while motor is running.* 	50/100	1%	100	100

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
DC Brake				**U[1]**	**K[1]**
A51	**[DC Brake Enable]** Used to enable/disable DC injection braking Settings: 00=Disabled 01=Enabled	00/01	Numeric Value	00	00
A52	**[DC Brake Start Frequency]** Sets the frequency at which the DC brake will become active.	0.5/10.0	0.1Hz	10.0	10.0
A53	**[DC Brake Wait Time]** Sets the time the drive will wait after **P**A52 - [DC Brake Start Frequency] before applying **P**A54 - [DC Hold Voltage].	0.0/5.0	0.1 seconds	0.0	0.0
A54	**[DC Hold Voltage]** Sets the level of DC braking voltage in percent of **P**A82 - [Base Voltage].	0/100	1% of drive rating	0	0
A55	**[DC Hold Time]** The time that **P**A54 -[DC Hold Voltage] is applied to the motor after **P**A53 - [DC Brake Waiting Time] has expired.	0.0/60.0	0.1 seconds	0.0	0.0
Operating Frequency Range				**U[1]**	**K[1]**
A61	**[Upper Frequency Limit]** This is an upper frequency limit similar to **P**A04 - [Maximum Frequency] except that it can be set lower than **P**A03 - [Base Frequency]. A value of 0.0 will disable this parameter. *Output Frequency*  	0.5/360.0	0.1Hz	0.0	0.0
A62	[**Minimum Frequency]** Lowest frequency the drive will output continuously. Refer to diagram in **P**A61 – [Upper Frequency Limit].	0.0/360.0	0.1Hz	0.0	0.0
A63	**[Skip Frequency 1]** Sets a frequency at which the drive will not output continuously.	0.0/360.0	0.1Hz	0.0	0.0
A64	**[Skip Frequency Band 1]** Sets the bandwidth around **P**A63 -[Skip Frequency 1]. The bandwidth is 2x **P**A64 – [Skip Frequency Band 1] with ½ the band below and ½ the band above **P**A63 - [Skip Frequency 1].	0.0/10.0	0.1Hz	0.5	0.5
A65	**[Skip Frequency 2]** Sets a frequency at which the drive will not output continuously.	0.0/360.0	0.1Hz	0.0	0.0
A66	**[Skip Frequency Band 2]** Sets the bandwidth around **P**A65 -[Skip Frequency 2]. The bandwidth is 2x **P**A66 - [Skip Frequency Band 2] with ½ the band below and ½ the band above **P**A65 - [Skip Frequency 2].	0.0/10.0	0.1Hz	0.5	0.5

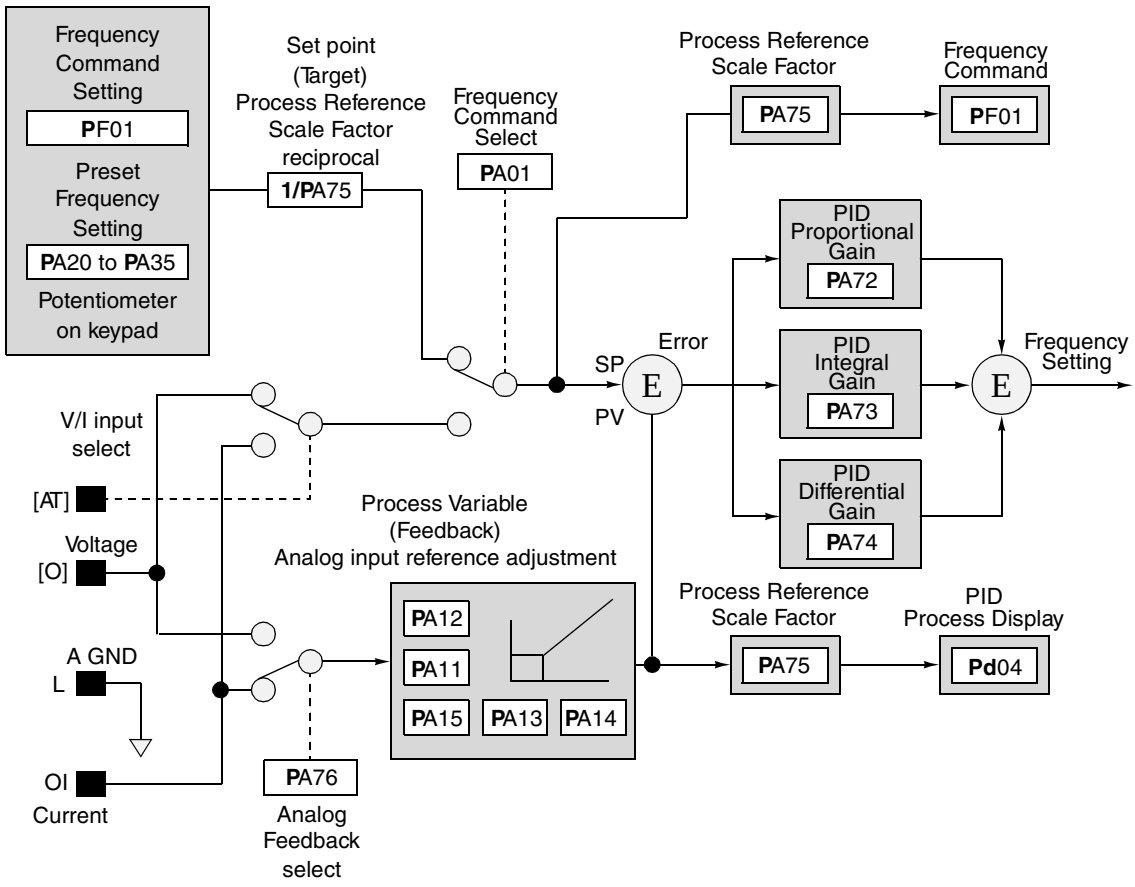
[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Operating Frequency Range cont.				**U[1]**	**K[1]**
A67	**[Skip Frequency 3]** Sets a frequency at which the drive will not output continuously.	0.0/360.0	0.1Hz	0.0	0.0
A68	**[Skip Frequency Band 3]** Sets the bandwidth around **P**A67 - [Skip Frequency 3]. The bandwidth is 2x **P**A68 - [Skip Frequency Band 3] with ½ the band below and ½ the band above **P**A67 - [Skip Frequency 3].	0.0/10.0	0.1 Hz	0.5	0.5
PID Controller				**U[1]**	**K[1]**
A71	**[PID Enable]** Used to disable / enable the use of PID control. Settings: 00=disable 01=enable *(See Figure 4.1 for PID block diagram)*	00/01	Numeric Value	00	00
A72	**[PID Proportional Gain]** Sets the proportional gain for the PID control. *This Parameter **can** be changed while motor is running.*	0.2/5.0	N/A	1.0	1.0
A73	**[PID Integral Gain]** Sets the integral gain for the PID control. *This Parameter **can** be changed while motor is running.*	0.0/150.0	0.1 seconds	1.0	1.0
A74	**[PID Differential Gain]** Sets the differential gain for the PID control. *This Parameter **can** be changed while motor is running.*	0.0/100.0	N/A	0.0	0.0
A75	**[Process Reference Scale Factor]** Used to scale the target value equivalent to the PID feedback value.	0.01/99.99	N/A	1.00	1.00
A76	**[Analog Feedback Select]** Selects the source from which the PID feedback originates Settings: 00=Input OI 01=Input O	00/01	Numeric Value	00	00
Automatic Voltage Regulation (AVR)				**U[1]**	**K[1]**
A81	**[AVR Function Select]** Used to select the Automatic Voltage Regulation function. Settings: 00=Active 01=Inactive 02=Inactive during deceleration	00/02	Numeric Value	02	02
A82	**[Base Voltage]** Set voltage to rated nameplate voltage of motor.	200/220/230 /240	Volts	230	230
Second Acceleration / Deceleration Ramp				**U[1]**	**K[1]**
A92	**[Accel Time 2]** Time for the drive to ramp from 0.0 Hz to **P**A04 - [Maximum Frequency]. **P**A94 - [Accel/Decel 2 Select] is used to determine when active. *This Parameter **can** be changed while motor is running*	0.1/3000	<1000, 0.1 s >1000, 1 s	15.0	15.0
A93	**[Decel Time 2]** Sets the time for the drive to ramp from **P**A04 - [Maximum Frequency] to 0.0 Hz. **P**A94 -[Accel/Decel2 Select] is used to determine when active. *This Parameter **can** be changed while motor is running.*	0.1/3000	<1000, 0.1 s >1000, 1 s	15.0	15.0

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Operating Frequency Range cont.				**U[1]**	**K[1]**
A94	**[Accel / Decel 2 Select]** Used to determine when the **P**A92 – [Accel Time 2] and **P**A93 - [Decel Time 2] are used. Settings: 00=Digital inputs (C01-C05) set to 09{2CH} 01=Automatic if frequency programmed in **P**A95 - [Accel 2 Start Frequency]/ **P**A96 - [Decel 2 Start Frequency] is reached.	00/01	Numeric Value	00	00
A95	**[Accel 2 Start Frequency]** Sets the frequency at which **P**A92 - [Accel Time 2] will take effect if **P**A94 - [Accel/Decel 2 Select] is set to 01.	0.0/360.0	0.1 Hz	30.0	0.0
A96	**[Decel 2 Start Frequency]** Sets the frequency at which **P**A93 - [Decel Time 2] will take effect if **P**A94 - [Accel/Decel 2 Select] is set to 01.	0.0/360.0	0.1 Hz	30.0	0.0
A97	**[Accel Curve]** Selects the type of acceleration curve. Settings: 00=Linear 01=S-curve	00/01	Numeric Value	00	00
A98	**[Decel Curve]** Selects the type of deceleration curve. Settings: 00=Linear 01=S-curve	00/01	Numeric Value	00	00

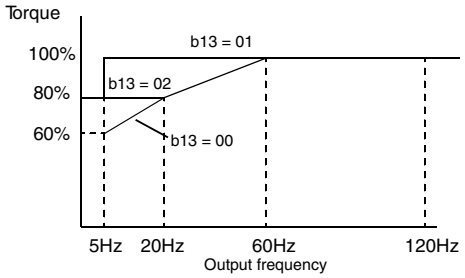
Figure 3.4 PID Loop Block Diagram



b Group – Advanced Control and Protection Parameters

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Automatic Start After a Fault				**U[1]**	**K[1]**
b01	**[Restart Mode Select]** Selects the restart mode for the drive Settings: 00=Fault indication 01=0 Hz start 02=Synchronize. 03=Synchr. and stop *Note: If set to 01, 02 or 03 the drive will attempt to restart the following number of times after the following events:* Overcurrent – 3 restarts Overvoltage – 3 restarts Undervoltage – 16 restarts (refer to **P**b03 – [Restart Time] for time between restart attempts) **ATTENTION:** This parameter may only be used as outlined in NFPA 79, "Under Voltage Protection." Equipment damage and/or personal injury may result if this parameter is used in an inappropriate application.	00/03	Numeric Value	00	00
b02	**[Power Loss Time]** If undervoltage exists longer than the programmed time, the drive will fault even if **P**b01 - [Restart Mode Select] is active.	0.3/25.0	0.1 seconds	1.0	1.0
b03	**[Restart Time]** Sets the time between restart attempts after an undervoltage fault or the removal of a digital input set to 11 {FRS}.	0.3/100.0	0.1 seconds	1.0	1.0

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Electronic Thermal Motor Protection				**U[1]**	**K[1]**
b12	**[Motor Overload Current]** Set to motor nameplate full load amps.	5/120% of rated current	0.01A	115% of drive rating	115% of drive rating
b13	**[Motor Overload Select]** Selects the characteristics of the electronic thermal motor protection. Settings: 00=Derating1 01=No Derating 02=Derating2 	00/02	Numeric Value	01	01

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Current Limit				**U**[1]	**K**[1]
b21	**[Current Limit Select]** Selects the mode for current limit. Settings: 00=Inactive 01=Active 02=Inactive in acceleration	00/02	Numeric Value	01	01
b22	**[Current Limit]** Sets the maximum output current allowed before current limiting occurs. Value set in percent of drive rated output current.	50/150% of rated current	0.01 A	150% of drive rating	150% of drive rating
b23	**[Current Limit Decel Time]** Sets the deceleration time when the current limiting occurs.	0.3/30.0	0.1 second	1.0	1.0
Parameter Protection				**U**[1]	**K**[1]
b31	**[Program Lock Select]** Sets the mode of program lock used. Settings: 00=All parameters locked when digital input setting 15 {SFT} active. 01=All parameters locked except **P**F01 – [Frequency Command] when digital input setting 15 {SFT} active. 02=All parameters locked 03=All parameters locked except **P**F01 – [Frequency Command].	00/03	Numeric Value	01	01
Current Feedback Tuning				**U**[1]	**K**[1]
b32	**[Reactive Current Setting]** Use to improve accuracy by calibrating drive motor combination. For improved accuracy, adjust this value during no load operation until **P**d02 - [Output Current] matches actual motor current.	0.00/100%	0.01A	40% of drive rating[2]	40% of drive rating

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

[2] 5hp (3.7 kW) ratings have a default value of 35%.

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Initialization / Adjustment Function				**U[1]**	**K[1]**
b81	**[Output FM Adjustment]** Sets the multiplier applied to output duty cycle for the FM analog signal. *This Parameter **can** be changed while motor is running.*	0/255	N/A	80	80
b82	**[Start Frequency]** Sets the frequency at which the drive will start. Refer to diagram in **P**A03 – [Base Frequency]	0.5/9.9	0.1 Hz	0.5	0.5
b83	**[PWM Frequency]** Carrier frequency for the PWM output waveform. Output current must be derated by twenty percent when set above 12 kHz.	0.5/16.0	0.1 kHz	5.0	5.0
b84	**[Reset Functions]** Resets the factory defaults or clears fault history. Settings: 00=Clear fault history 01=Reset defaults ***Note:** To activate this parameter, set the value and press the Enter Key, then hold the SELect, Up, Down, and STOP Keys for 3 seconds, release only the STOP Key until display is blinking, then release all of the keys.* ***Note:** Defaults will reset to factory settings determined by **P**b85 – [Factory Defaults Select]*	00/01	Numeric Value	01	00
b85	**[Factory Default Select]** Determines the default settings of all parameters. The drive will reset to these default values when a "reset defaults" command is executed as described in **P**b84, setting 01 = reset defaults. Settings: 06=K (50 Hz default settings) 07=U (60 Hz default settings) ***Note**: Parameter default values for settings 00 - 05 are not published in this manual and are not recommended. If using these default settings **P**b87 becomes active. Refer to the Attention statement under **P**b87.*	06/07	Numeric Value	07	06
b86	**[Process Display Scale Factor]** Sets the frequency factor for **P**d07 –[Process Display]. Also sets the multiplier that is applied to the output frequency for the FM pulse signal. *This Parameter **can** be changed while motor is running*	0.1/99.9	N/A	30.0	1.0
b87	**[STOP Key Select]** This parameter is not active when **P**b85 is set to setting 06 or 07. **ATTENTION:** If **P**b85 settings 00 through 05, are activated, this parameter will control the operation of the keypad STOP key. Setting 00 will enable the STOP key and 01 will disable the STOP key. Disabling the STOP key is not recommended as it could result in personal injury, loss of life or equipment damage.	00/01	Numeric Value	00	00

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Initialization / Adjustment Function				**U[1]**	**K[1]**
b88	**[FRS Select]** Selects operation of the drive after a digital input (C01 – C05) setting 11{FRS} input is removed. Settings: 00=0 Hz start 01=Synchronization of motor speed after waiting period programmed via **P**b03 – [Restart Time].	00/01	Numeric Value	00	00
b89	**[Reserved]** Reserved for Future Use, **DO NOT CHANGE**	01/07	Numeric Value	01	01
b92	**[Reserved]** Reserved for Future Use, **DO NOT CHANGE**	00/01	00		

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

C Group – Intelligent I/O and Communication Parameters

This parameter group is used to program the functions of the digital and analog I/O.

ATTENTION

- All digital inputs respond to level sensitive commands.
- Inputs do not require a voltage transition (cycle) after a fault condition is cleared, after input power cycling or after programming the logic of the digital input.
- All digital inputs can be programmed as NO or NC. HOWEVER, The **START** COMMAND SHOULD BE SET AS **NO (ACTIVE HIGH)** AND THE **STOP** COMMAND SHOULD BE SET AS **NC (ACTIVE OPEN).** If set opposite of this, an inadvertent start or failure to stop could occur should a discrete connection be lost or control wire come loose. IF THE USER CHOOSES TO DISREGARD THIS SAFETY PRACTICE – THE RISK ASSUMED BY THE USER CAN BE REDUCED BY ASSURING THAT OTHER SAFEGUARDS ARE USED TO INSURE PROPER START AND STOP OPERATION. Depending on the application: This may include appropriate emergency stops, redundant wiring, electronic guards and/or mechanical guards. Failure to observe this precaution could result in severe bodily injury or loss of life.

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Digital Inputs 1 – 5				**U[1]**	**K[1]**
Parameter					
C01	**[Digital Inputs 1-5]** Used to program the function of digital inputs 1 – 5. Settings: 00={FW} (Forward) 01={RV} (Reverse) 02={CF1} (Preset Frequency Input) 03={CF2} (Preset Frequency Input) 04={CF3} (Preset Frequency Input) 05={CF4} (Preset Frequency Input) 06={JG} (Jog) 09={2CH} (Accel/Decel 2 Select) 11={FRS} (Coast to Stop) 12={EXT} (External Trip) 13={USP} (Unintentional Start Protection) 15={SFT} (Program Lock) 16={AT} (4-20mA Select) 18={RS} (Reset) 19={PTC} (PTC Input) *input C05 only* 20={STA} (3 Wire Run) 21={STP} (3 Wire Stop) 22={F/R} (3 Wire Forward/Reverse) 27={UP} (Remote Control Up) 28={DWN} (Remote Control Down) 31={OPE} (Run/Stop Command Source Select) Refer to Chapter 2 for setting descriptions of the "Programmable Digital Input Functions" listed above.	00/31	Numeric Value	22	00
C02				20	01
C03				21	02
C04				18	03
C05				13	13
C11	**[Digital Inputs 1-5 Logic]** Sets the digital inputs to be NO or NC contacts Settings: 00=NO contact (active high) 01=NC contact (active open)	00/01	Numeric Value	00	00
C12				00	00
C13				01	00
C14				00	00
C15				01	01
Outputs 11, 12, FM, AL0-AL1				**U[1]**	**K[1]**
C21	**[Digital Outputs 11-12]** Sets the operation of the digital outputs Settings: 00={RUN} (Motor running above 0.5 Hz) 01={FA1} (At frequency and above 0.5 Hz) 02={FA2} (Above frequency) 03={OL} (Overload alarm) 04={OD} (PID deviation) 05={AL} (Fault) Refer to control terminal table in Chapter 2 for setting descriptions.	00/05	Numeric Value	01	01
C22				00	00

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using Pb85 – [Factory Default Select]

Parameter Number	Parameter Name / Description	Min./Max Range	Units	Factory Defaults	
Outputs 11, 12, FM, AL0-AI1				**U[1]**	**K[1]**
C23	**[Output FM Select]** Sets the operation of the output FM. Settings: 00={A-F} (Analog Output Frequency) 01={A} (Motor Current) 02={D-F} (Digital Output Frequency) Refer to control inputs table in Chapter 2 for setting descriptions.	00/02	Numeric Value	00	00
C31	**[Digital Output 11-12 Logic]** Sets the digital outputs to be NO or NC contacts. Settings: 00=NO contact (Active high) 01=NC contact (Active open)	00/01	Numeric Value	00	00
C32				00	00
C33	**[Fault Relay AL1 Logic]** Sets the fault relay to be either NO or NC contacts. Settings: 00 = NO contact (active high) 01 = NC contact (active open) Refer to control inputs table in Chapter 2 for setting descriptions.	00/01	Numeric Value	01	01
C41	**[Overload Alarm Threshold]** Sets the allowable overload level before digital outputs 11-12 change state when set to 03 {0L}.	0/200% of drive rating	0.01 A	100% of drive rating	100% of drive rating
C41	**[Overload Alarm Threshold]** Sets the allowable overload level before digital outputs 11-12 change state when set to 03 {0L}.	0/200% of drive rating	0.01 A	100% of drive rating	100% of drive rating
C42	**[Above Frequency Accel Threshold]** Sets the frequency at which digital outputs 11-12 change state when set to 02 {FA2} if the drive is accelerating.	0.0/360.0	0.1 Hz	0.0	0.0
C43	**[Above Frequency Decel Threshold]** Sets the frequency at which digital outputs 11-12 change state when set to 02 {FA2} if the drive is decelerating.	0.0/360.0	0.1 Hz	0.0	0.0
C44	**[PID Deviation Threshold]** Sets the allowable PID Loop error before digital outputs 11-12 change state when set to 04 {OD}.	0.0/100%	+/- 0.1%	+/-3.0	+/-3.0
Communications				**U[1]**	**K[1]**
C70	**[Unassigned]**				
C71	**[Unassigned]**				
C72	**[Unassigned]**				
C79	**[Unassigned]**				
C91	**Debug Mode** Used by Rockwell Automation field service personnel. **ATTENTION** If **P**C91-[Debug Mode] is set to 01 parameters **P**C92-**P**C95 are enabled. Changing parameters **P**C92-**P**C95 can lead to personal injury, death, or equipment damage. DO NOT CHANGE PARAMETERS **P**C91-**P**C95.				

[1] U = 60 Hz default settings, K = 50 Hz default settings. Settable using **P**b85 – [Factory Default Select]

Chapter 4 – Faults & Troubleshooting

Fault Information

This chapter provides information to guide you in troubleshooting the drive. Included is a list and description of drive faults and problems that may occur.

How to Clear a Fault

When a fault occurs, the cause must be corrected before the fault can be cleared. After corrective action has been taken, any of the following actions will clear the fault.

- Press the stop button on the Keypad.
- "Reset" the drive via a digital input that is programmed to setting 18 {RS}.
- Cycle power to the drive.

ATTENTION

- **A hazard of personal injury or equipment damage exists. If a fault is cleared while there is a valid run command, the drive will run as soon as the fault is cleared without cycling the input.**

Note: If any digital input (**C**01-**C**05) is set to 31 {OPE} then the setting of parameter **A**02 is ignored as the digital input overrides this setting. If the input is programmed, but not active, the start command will come from the control terminals. If the input is programmed and active, the start command will come from the start key on the keypad.

Bulletin 161 Fault Descriptions

Fault Number	Fault Name	Fault Description	Corrective Action
E 01	Overcurrent While running	An overcurrent has been detected in the hardware trip circuit while the drive was running.	Check for a short circuit at the drive output or for excessive load conditions at the motor.
E 02	Overcurrent During Deceleration	An overcurrent has been detected in the hardware trip circuit while the drive was decelerating.	Check for a short circuit at the drive output or for excessive load conditions at the motor.
E 03	Overcurrent During Acceleration	An overcurrent has been detected in the hardware trip circuit while the drive was accelerating.	Check for a short circuit at the drive output, excessive load conditions at the motor, an acceleration time that is too short, or for a manual boost setting that is improperly set.
E 04	Overcurrent at a Standstill	An overcurrent has been detected in the hardware trip circuit while the drive was at a standstill.	Check the output lines or the motor for a ground fault.
E 05	Internal Motor Protection	The internal electronic motor protection has been triggered due to overloading of the connected motor.	Check the entry under **P**b12 - [Motor Overload Current]. Reduce **P**A42 - [Manual Boost Voltage]. Check the motor and drive rating.
E 07	Overvoltage	The maximum DC Bus Voltage has been exceeded due to regenerative energy from motor.	Motor regeneration has caused a bus overvoltage. Extend the decel time.
E 08	EEPROM Error	The EEPROM has invalid data.	Reset EEPROM by resetting the defaults using **P**b84 - [Reset Functions].
E 09	Undervoltage	The DC Bus voltage fell below the minimum rated voltage.	Monitor the incoming AC line for low voltage or line power interruptions.
E 11	Processor Error	There is a malfunction or abnormality of the CPU	Check external wiring for a possible cause. If problems persist have drive serviced by authorized Rockwell-Automation service personnel.
E 22	Processor Error		
E 12	External Fault	External fault 12 {EXT} indication has been received at one of the digital inputs (C01-C05).	Remove the cause of the fault in the external wiring and clear the fault.
E 13	Unintentional Start Protection	An input (C01-C05) was set to 13 {USP} and power was restored while a run input was active.	Check incoming line voltage for low voltage or line power interruptions. Remove the run command before power-up.

* For a description of the reset function see digital input description table in Chapter 2, and parameters **P**C01 [Digital Input 1] - **P**C05 [Digital Input 5] in Chapter 3.

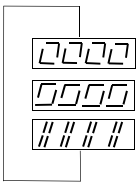
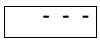
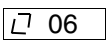
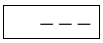
Fault Number	Fault Name	Fault Description	Corrective Action
E 14	Ground Fault	There was a ground fault at the motor output terminals.	Check for a ground fault at the output terminals.
E 15	Excess Input Voltage	The input voltage is higher than permitted.	Check the incoming AC line.
E 21	Overtemperature fault	Excessive heat has been detected inside the drive.	Clear blocked or dirty heat sink fins. Check ambient temperature. Check for proper clearance distances. On models with a fan, check for fan operation. Check for excessive motor load.
E 35	PTC circuit triggered.	The resistance from the external thermistor was too large. (Greater than 3 kΩ)	Check for an overload condition at the motor, or check for proper ventilation at the motor.
E 60	Communication Error	A loss of communication has occurred.	Check communication connections.

Possible Problems and Corrective Actions

Problem	Corrective Action
The motor does not start.	1. Check the power circuit. • Check the supply voltage. • Check all fuses and disconnects. 2. Check the Motor. • Verify that the motor is connected properly. • Verify that no mechanical problems exist. 3. Check the control input signals. • Verify that the start signal is present. • Verify that either the Run Forward or Run Reverse signal is active, but not both. • Verify wiring of H, O, and L terminals if a remote speed pot is being used. • If using 3 wire start, ensure that a 3 wire stop is programmed. • Verify that the reset command {RS} is not active. 4. Check the setting of **P**A01-[Frequency Command Select]. 5. Check setting of **P**A02 - [Start Command Select]. • If set to keypad start check **P**F04-[Start Key Direction], when set to 02, the 00 {FW} or 01 {RV} digital input must be active before pressing start key. • If set to keypad control, ensure that a jumper is connected between terminals 3 and P24. 6. If any digital input is set to 31{OPE} then the setting of A02 is ignored as the digital input overrides this setting. The start command will come from the control terminals. If the input is programmed, but NOT active the start command will come from the control terminals. If the input is programmed AND active the start command will come from the Start key on the keypad.
The direction of motor rotation is incorrect.	1. Check the motor output connections, reverse two of the three phases if necessary. 2. Check that the control inputs have been wired correctly. 3. If using 3 wire control ensure that the 3 wire forward/reverse input is programmed. 4. Check setting of **P**F04 – [Start Key Direction].

Problem	Corrective Action
The motor does not accelerate properly.	1. Check to see that a frequency has been commanded. 2. Check to see if a preset frequency has been selected. 3. Check to see if the motor load is too high. 4. Check to see if the acceleration time is too long. 5. Check to see if manual boost and current limit are set properly.
The speed of the motor does not match the frequency.	1. Check to see that the maximum frequency has been entered correctly. 2. Check the rated speed of the motor and the reduction ratio of the gear. 3. Check to see if manual boost and current limit are set properly. 4. If PID control is used, check gain adjustments.
The motor runs unstable.	1. If sudden high load changes occur, choose a drive and motor with higher ratings or reduce the load changes. 2. If resonant frequencies occur in the motor, set up skip frequency bands. 3. If the input voltage is not constant, change the PWM carrier frequency.
The parameters stored do not match the values entered.	1. When the input voltage was switched off the entered values were transferred to the power-failure safe EEPROM. Reprogram the values and wait at least 6 seconds before powering down.
No entries can be made.	1. Check to see if the parameter protection is activated via a digital input setting of 15 {SFT}.
The electronic motor protection (fault E05) is triggered.	1. Check the manual boost setting to see if it is too high. 2. Check the electronic motor protection setting to make sure that it is correct.

Other Displays

Display	Description
	A reset signal has been issued. The Bulletin 161 drive is in standby mode. Note: If motor was running when the 18 {RS} input was received, the motor will coast to a stop.
	The input voltage has been switched off.
	The waiting time before automatic restart has expired (see **P**b01-*[Restart Mode Select]* - **P**b03-*[Restart time]*).
	The factory setting has been selected and the drive is in the initialization phase (see **P**b84-*[Reset Functions],* **P**b85-*[Factory Defaults Select]*). If your drive is a K version, parameters for the 50Hz version are loaded. If your drive is a U version, parameters for the 60 Hz version are loaded.
	No data present or the function is not active.

This Page Intentionally Blank

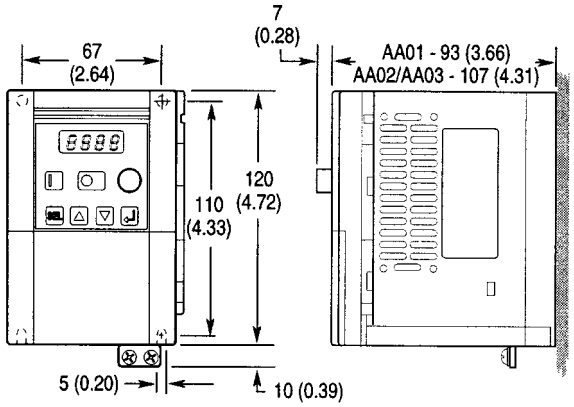
Chapter 5 – Specifications & Dimensions

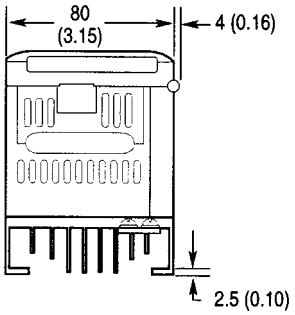
Technical Data

Series	Bulletin 161							
Type	**A01**	**A02**	**A03**	**A04**	**A05**	**A07**	**A10**	**A15**
Drive rating kW (HP)	0.2 (0.3)	0.4 (0.5)	.55 (.75)	0.75 (1)	1.1 (1.5)	1.5 (2)	2.2 (3)	3.7 (5)
115V Input rated current (A)	5.5	10.0	N/A	16.0	N/A	N/A	N/A	N/A
230V 1F Input rated current (A)	3.1	5.8	6.7	9.0	11.2	16.0	22.5	N/A
230V 3F Input rated current (A)	1.8	3.4	3.9	5.2	6.5	9.3	13.0	20.0
Output rated current (A)	1.4	2.6	3.0	4.0	5.0	7.1	10.0	15.9
Power Dissipation (W)	17	29	33	41	53	70	101	169
Mass (kg)	See dimension drawings on following page.							
Input voltage (V)	200 V -10% to 240 V + 5%, 50/60 Hz +/- 5%; 100V -5% to 120V +5%							
Output voltage	3 Φ adjustable from 0 to 230V							
Type of protection	IP20							
PWM carrier frequency	0.5 - 16 kHz							
V/Hz characteristics	Programmable V/Hz ratio, V/Hz control (constant torque, variable torque)							
Type of control	Voltage-driven, PWM sine weighted, IGBT-Power module							
Output frequency	0.5 - 360 Hz							
Accuracy of frequency command	Digital: +/- 0.01% of max. frequency Analog: +/- 0.2% of max. frequency							
Frequency resolution	Digital: 0.1 Hz, analog: 0.01% of max. frequency							
Overload capacity	Software: 150% for 60 s (once in a period of 10 min.), Hardware: 220%							
Starting torque	min. 150% at frequencies >3 Hz							
DC brake	Starting frequency, braking torque, running times are variable.							
Analog inputs	0 -10 V, input impedance 10 kΩ 4 - 20 mA, input impedance 250 Ω PTC input							
Digital inputs	5 programmable level triggered inputs, 24V PNP logic, NO or NC contacts							
Analog outputs	1 programmable output. 0-10V, 1mA, Accuracy: +/- 5% for frequency, +20% for current.							
Digital outputs	2 open collector outputs. 27VDC, 50mA							
Relay output	1 fault indication relay (change-over contact) Resistive rating: 2.5A at 250VAC – 3A at 30VDC Inductive rating: 0.2A at 250VAC – .7A at 30VDC							
Protection functions	Over-current, over-voltage, under-voltage, electronic motor protection, over-temperature, ground fault, overload etc. (see Chap.4).							
Other functions	15 preset speeds, PID control, unintentional start protection, RS422 serial interface, skip frequencies etc.							
Ambient temperature	-10 - +40 °C (up to +50 °C by removing top cover, reducing carrier frequency to 2kHz, and derating output current by 20%)							
Relative humidity	20 - 90% relative humidity, no condensation							
Vibration/Shock	Vibration: 0.6G operational / Shock: 10.0G operational							
Max. installation altitude	1000 m (3300 ft.) above sea level							
Options	Line filter modules							
Standards	EN 61800-3 EMC guidelines in connection with optional line filter modules in line with installation guidelines, EN 50178 Low-Voltage guideline, CSA 22.2 CE N223							

Figure 5.1 Bulletin 161 Dimensions
(All dimensions are in millimeters and (inches).

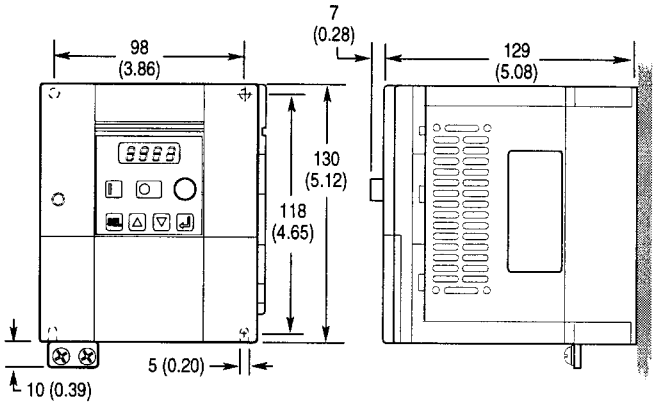
AA01 / AA02 / AA03

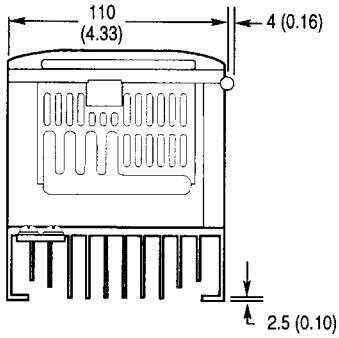




Mass Kg (lb)
AA01
0.7 (1.54)
AA02/AA03
0.85 (1.87)

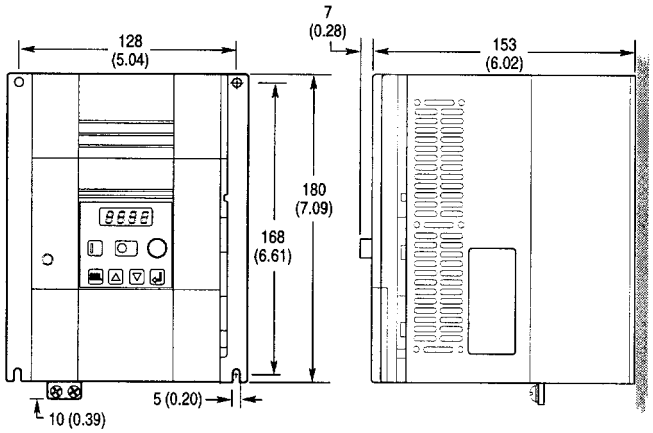
AA04 / AA05

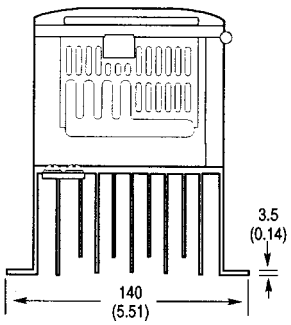




Mass Kg (lb)
AA04/AA05
1.3 (2.87)

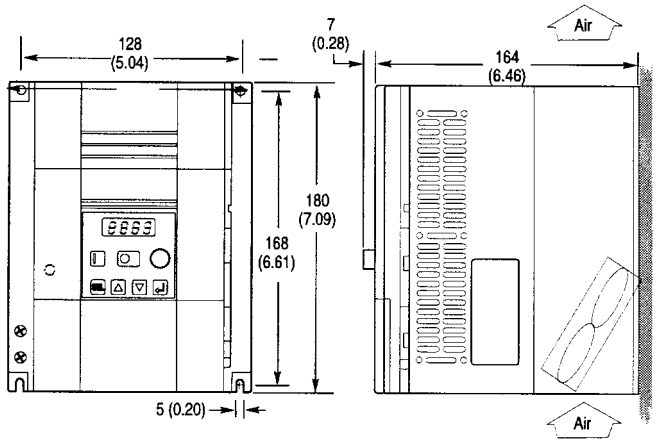
AA07

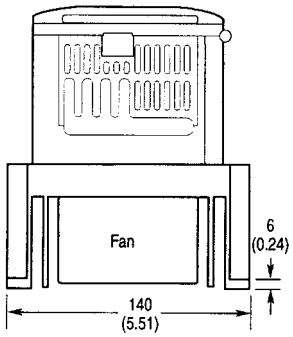




Mass Kg (lb)
AA07
2.2 (4.85)

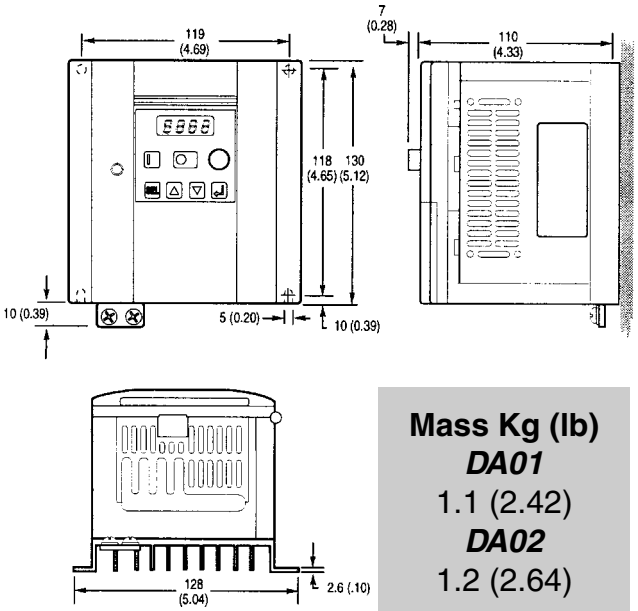
AA10/AA15





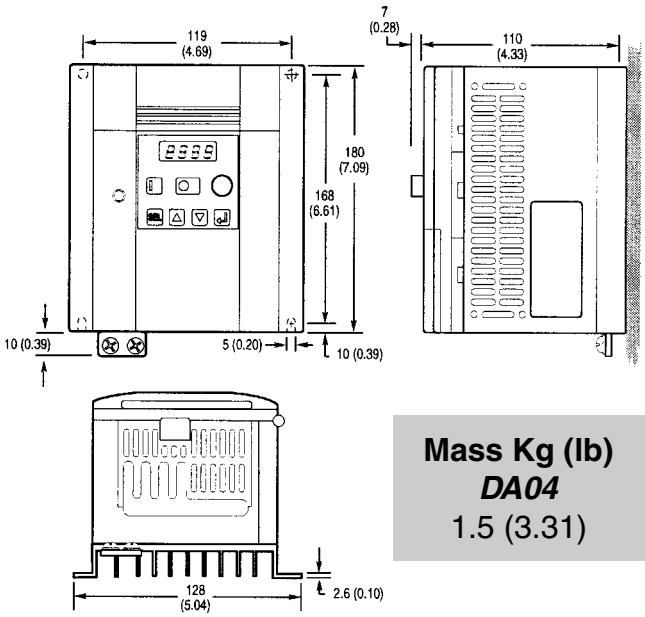
Mass Kg (lb)
AA10/AA15
2.8 (6.17)

DA01 / DA02



Mass Kg (lb)
DA01
1.1 (2.42)
DA02
1.2 (2.64)

DA04



Mass Kg (lb)
DA04
1.5 (3.31)

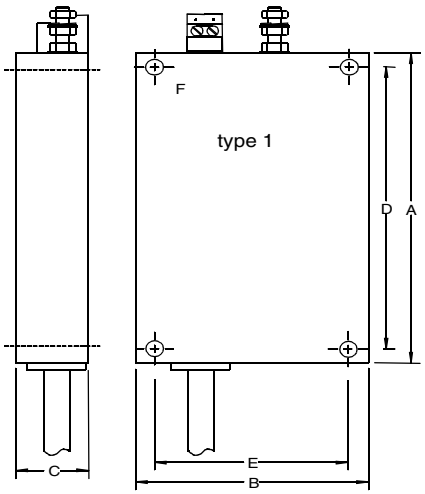
Accessories

Line Filter Module Specifications

Line Filter Module	Nominal Voltage [V]	Nominal Current at 40°C [A]	Leakage Current at 50 Hz (mA)	Test voltage [VDC for 2s] ph. to ph; ph. to grd	Input wire max. cross section [mm^2 (in^2)]	Output cable cross section [mm^2 (in^2)]	Heat dissipation [W]
161S-RFD-10-B	120 +5%	10 A	< 3.5	NA	4 (.006)	1.5 (.002)	NA
161S-RFD-16-C	120 +5%	16 A	< 3.5	NA	4 (.006)	1.5 (.002)	NA
161S-RFA-7-A	240 +5%	7 A	< 3.5	1400 / 2800	4 (.006)	1.5 (.002)	6
161S-RFA-12-B	240 +5%	12A	< 3.5	1400 / 2800	4 (.006)	1.5 (.002)	7
161S-RFA-22-C	240 +5%	22A	< 15	1400 / 1400	4 (.006)	2.5 (.004)	9
161-RFA-4-A	240 +5%	4A	< 3.5	1400 / 2800	4 (.006)	1.5 (.002)	NA
161-RFA-7-B	240 +5%	7A	< 3.5	1400 / 2800	4 (.006)	1.5 (.002)	NA
161-RFA-20-C	240 +5%	20A	< 3.5	1400 / 1400	4 (.006)	2.5 (.004)	NA

Current:	at 40°C ambient temperature
Overload:	150% I_N for 10 min
Frequency:	50 / 60 Hz
Material:	steel, surface finished
Humidity class:	C
Operation height:	< 1000 m (3200 ft.) without derating > 1000 m, I_N-2%, for each 1000m
Temperature range:	-25°C to +85°C
Connections	Input terminals IP 20 and PE-screw M5 Load side: cable, unshielded

Figure 5.2 Line Filter Module Dimensions [mm (in)]:



Line Filter Selection Guide			
Drive Ratings	Input Voltage	1Φ Series B Line Filter Module	3Φ Series B Line Filter Module
S-DA01 S-DA02	100V - 120V	161S-RFD-10-B	N/A
S-DA04	100V - 120V	161S-RFD-16-C	N/A
S-AA01 S-AA02 S-AA03	200V - 240V 200V - 240V 200V - 240V	161S-RFA-7-A	161-RFA-4-A
S-AA04 S-AA05	200V - 240V	161S-RFA-12-B	161-RFA-7-B
S-AA07 S-AA10	200V - 240V	161S-RFA-22-C	161-RFA-20-C
S-AA15	200V - 240V	N/A	161-RFA-20-C

Line Filter Module	A	B	C	D	E	F
161S-RFD-10-B	130 (5.12)	128 (5.04)	27 (1.06)	118 (4.65)	119 (4.69)	4 x 6 (.24)
161S-RFD-16-C	180 (7.09)	128 (5.04)	27 (1.06)	168 (6.61)	119 (4.69)	4 x 6 (.24)
161S-RFA-7-A	120 (4.72)	80 (3.15)	25 (0.98)	110 (4.33)	67 (2.64)	2 x 6 (.24)
161S-RFA-12-B	130 (5.12)	110 (4.33)	27 (1.06)	118 (4.65)	98 (3.86)	4 x 6 (.24)
161S-RFA-22-C	180 (7.09)	140 (5.51)	29 (1.14)	168 (6.61)	128 (5.04)	4 x 6 (.24)
161-RFA-4-A	120 (4.72)	80 (3.15)	25 (0.98)	110 (4.33)	67 (2.64)	2 x 6 (.24)
161-RFA-7-B	130 (5.12)	110 (4.33)	27 (1.06)	118 (4.65)	98 (3.86)	4 x 6 (.24)
161-RFA-20-C	180 (7.09)	140 (5.51)	29 (1.14)	168 (6.61)	128 (5.04)	4 x 6 (.24)

Appendix A – CE Conformity

CE Compliance

This drive is a component intended for implementation in machines or systems for the industrial environment. It is CE marked for conformity to the Low Voltage (LV) directive 73/23/EEC when installed as described. It also has been tested to meet the Council Directive 89/336 Electromagnetic Compatibility (EMC). The standards used for this testing are, LV: EN50178, EN60204-1, EN60950, EMC: EN61800-3 (EN55011, Group 1, Class B (Industrial Environment)).

General Notes and Instructions

- The motor cable should be kept as short as possible in order to avoid electromagnetic emission as well as capacitive currents. The cable length increases the capacitive current and electromagnetic emission.
  It is recommended that the motor cable length does not exceed 50m.
  It is always recommended to install output reactors if the cable length exceeds 50m.
- The filters contain capacitors between the phases and the phases to ground as well as suitable discharging resistors, but after switching off the line voltage wait a minimum of 60 seconds before removing protective covers or touching terminals to avoid an electric shock.
- The use of ground fault monitoring devices (RCD's) is not recommended. If unavoidable, only monitoring devices which are suited for DC, AC and High Frequency ground currents (type B RCD's) should be used. It is recommended to use devices whose responsiveness and time characteristics are adjustable, to avoid nuisance tripping during power up of the drive.
- The thermal capacity of the line filter is guaranteed up to a maximum motor cable length of 50m.
- The line filters have been developed for use in grounded systems. Use in ungrounded systems is not recommended.

Essential Requirements for a Conforming EMC Installation

The following items are required for CE conformance.

1. An input filter module (See Chapter 5 Specifications and Dimensions) must be installed to reduce conducted emissions.
   Compliance of the Bulletin 161 drive to the conducted emissions levels with appropriate line filter module is as follows:

PWM Carrier Frequency	Motor Cable Length	Limit
</= 16kHz	10m	Class B
</= 5kHz	20m	Class B
</= 16kHz	50m	Class A

2. Grounding of equipment and cable shields must be solid with low impedance connections.
3. All motor cables must use shielded cable, or be in grounded metal conduit.
4. All control and signal wiring must use shielded cable or be in grounded metal conduit.
5. Ensure that the protective earth ground terminal (PE) of the filter is properly connected with the protective earth ground terminal of the drive. The filter must be solidly and permanently connected with the ground potential to avoid electric shock.

General Instructions for an EMC Compliant Installation

Motor Cable

- The cable between the drive and motor must be 4-wire shielded cable (three phases and ground).
- Do not exceed the maximum motor cable length for the specific line filter module used.

Control Cable

- Control wiring must use shielded cable or grounded metal conduit.
- The shield must be connected to PE at both ends of the cable.

This Page Intentionally Blank

www.rockwellautomation.com

Power, Control and Information Solutions Headquarters

Americas: Rockwell Automation, 1201 South Second Street, Milwaukee, WI 53204-2496 USA, Tel: (1) 414.382.2000, Fax: (1) 414.382.4444
Europe/Middle East/Africa: Rockwell Automation, Vorstlaan/Boulevard du Souverain 36, 1170 Brussels, Belgium, Tel: (32) 2 663 0600, Fax: (32) 2 663 0640
Asia Pacific: Rockwell Automation, Level 14, Core F, Cyberport 3, 100 Cyberport Road, Hong Kong, Tel: (852) 2887 4788, Fax: (852) 2508 1846

Publication 0161-5.0MU – March, 2001
Supersedes 161-5.0MU dated September, 2000

NB591XA

Copyright 2001 Rockwell International Corporation. All rights reserved. Printed in USA